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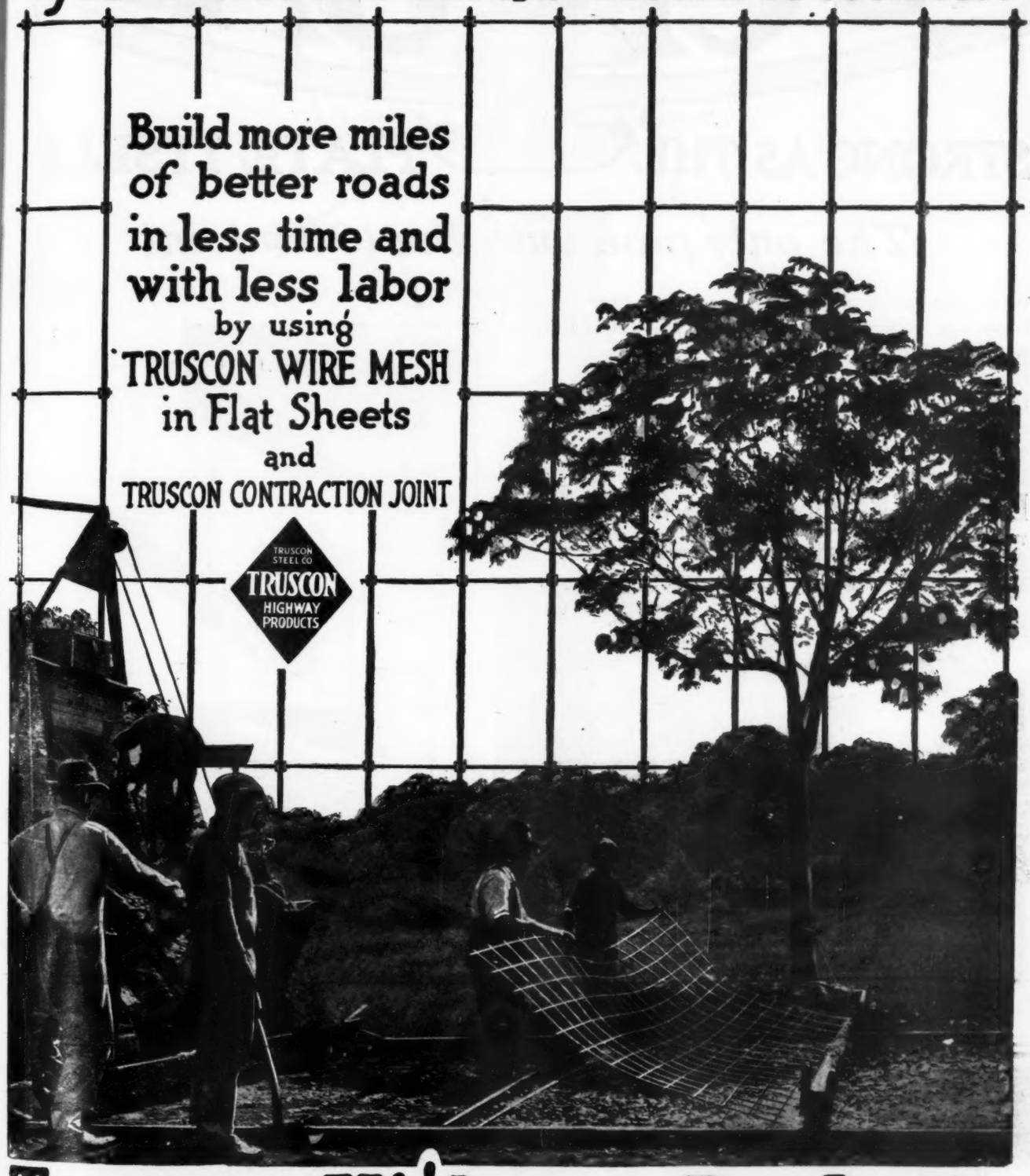

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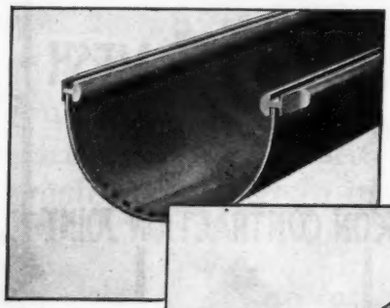


Fig. 11
Applying
The "Lock-Bars"

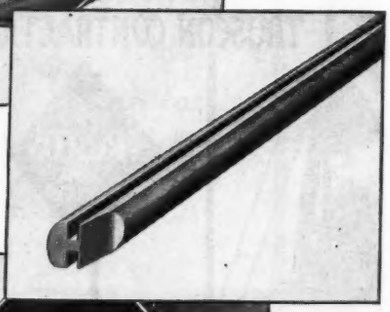


Fig. 12
Scarfed
"Lock-Bar"

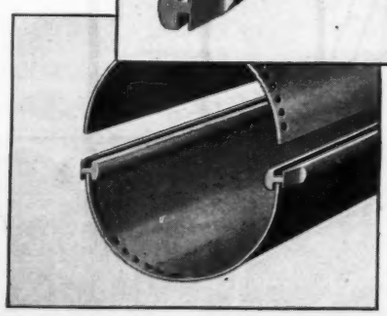
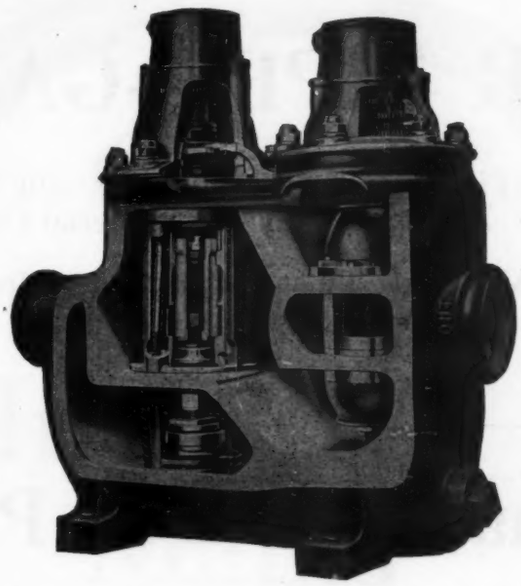


Fig. 13
Assembling
Halves



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PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 53 September, 1922 No. 7

Constructing Scituate Reservoir

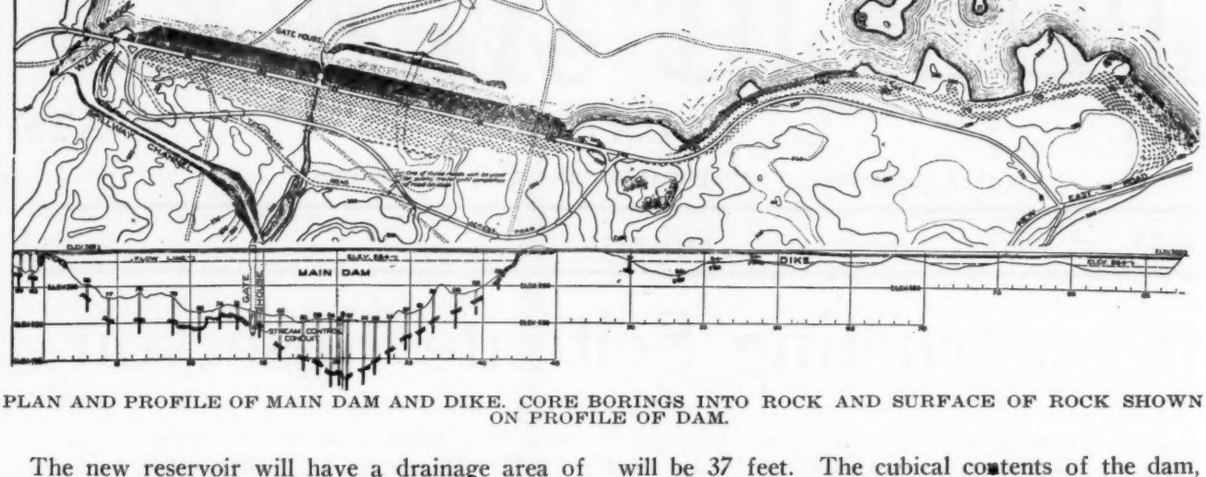
Construction of a dam and dike nearly one and a third miles in combined length to furnish improved water supply for Providence, R. I. Contractor's modernly equipped camp. Steamshovel work, complicated by quicksand and boulders. Traveling cableway for deepest excavation.

The water supply for the City of Providence, Rhode Island, which since December 1, 1871, has been taken from the Pawtuxet River at a point ten feet above mean high tide, requires an amount considerably greater than the normal dry weather flow of that stream. Moreover, the stream here is highly polluted and for some years the water has been filtered. In order to obtain a less polluted water, abundant storage and a gravity supply, the Scituate Reservoir is being built. It will be formed by the construction of an earth dam and dike across the valley of the north branch of the Pawtuxet River, two miles north of Hope, R. I., and about 10 miles from the City Hall of Providence.

GENERAL DESCRIPTION

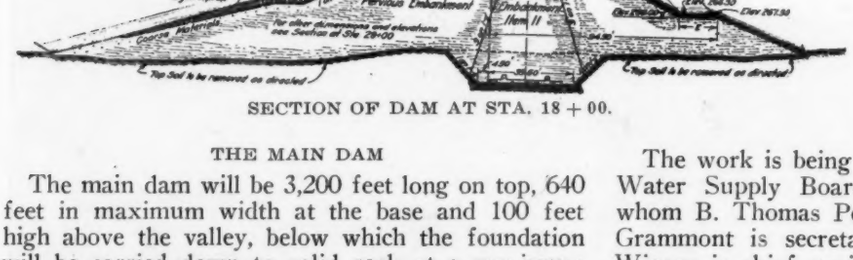
The reservoir will have a capacity of about 36,900,000,000 gallons. It will deliver water by gravity to an elevation at least 50 feet higher than that of the present distributing reservoir, or 232 feet above tide water. A new filter plant will be built and a seven-mile aqueduct which will have a capacity of 85,000,000 gallons daily (nearly four times the average consumption in 1921) will connect with the existing pipe system of the city.

CORE TRENCH, SHOWING ROCK SURFACE, CONCRETE BLANKET AND CUT-OFF WALLS AND STARTING OF IMPERVIOUS CORE.



PLAN AND PROFILE OF MAIN DAM AND DIKE. CORE BORINGS INTO ROCK AND SURFACE OF ROCK SHOWN ON PROFILE OF DAM.

The new reservoir will have a drainage area of 92.8 square miles, a water surface of 3,600 acres, an average depth of water of 32 feet, a flow line elevation 284 feet above high water in Providence Harbor, and a length of flow line of 38 miles. It will involve the construction of 26 miles of new highways and the abandonment of 34.7 miles of old roads. It will contain 28 islands and will submerge a number of small cemetery sites, which contained about 1,480 graves the remains from which have been transferred to a new cemetery. In the condemned area there are 375 dwelling houses, 7 school houses, 6 churches, 6 cotton mills, and many other buildings.



SECTION OF DAM AT STA. 18 + 00.

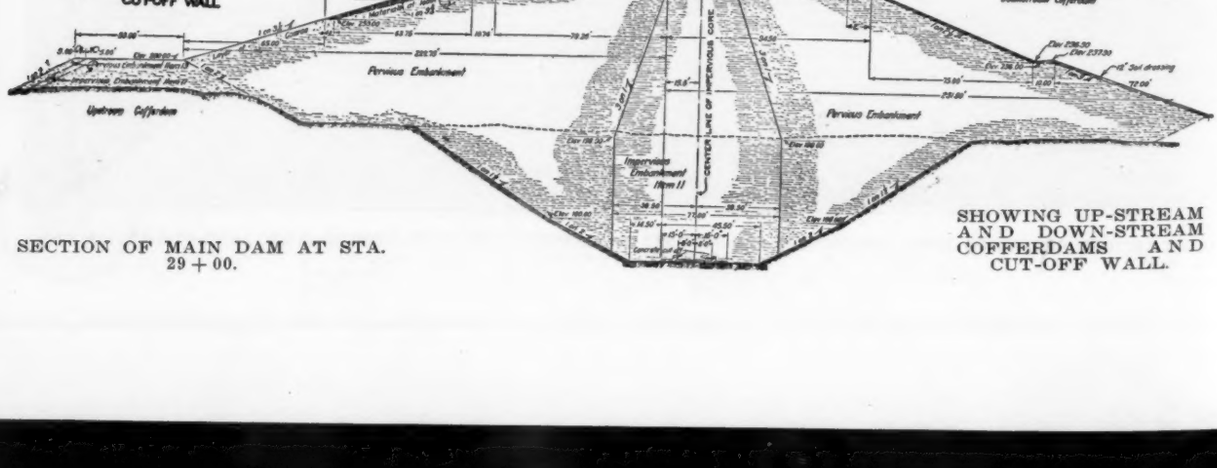
THE MAIN DAM

The main dam will be 3,200 feet long on top, 640 feet in maximum width at the base and 100 feet high above the valley, below which the foundation will be carried down to solid rock at a maximum depth of about 80 feet below the old stream bed. The thickness of the dam at flow line will be 118 feet; the width at the top, 13 feet above flow line, will be 37 feet. The cubical contents of the dam, including refilling below the surface of the ground, will be about 2,500,000 cubic yards. There will be a spillway with a clear length of 413 feet and a spillway channel to the river below the dam about 1,800 feet long.

THE DIKE

The dam will be supplemented by an earth dike about 4,000 feet long, 33 feet in maximum height and 15 feet in average height, which will be constructed substantially like the dam, and will contain about 200,000 cubic yards of material. The watertightness of the dam will be secured by a central core 77 feet in maximum thickness, composed of selected soil stripped from the reservoir basin and thoroughly compacted in 6-inch layers by heavy steam rollers. The upstream face of the dam will be protected against wave action by heavy riprap and the downstream face will be covered with top soil and grassed.

The work is being done under the direction of a Water Supply Board having seven members, of whom B. Thomas Potter is chairman. Samuel N. Grammont is secretary for the board, Frank E. Winsor is chief engineer, J. Waldo Smith is consulting engineer, William W. Peabody is deputy chief engineer in charge of Dam and Aqueduct Division, Frank E. Waterman is division engineer in



SECTION OF MAIN DAM AT STA. 29 + 00.

SHOWING UP-STREAM AND DOWN-STREAM COFFERDAMS AND CUT-OFF WALL.

charge of Reservoir Division, and Francis B. Marsh is designing engineer.

PRELIMINARY WORK

Up to July 1, 15 major and 5 minor contracts, ranging from about $610 to $3,500,000, had been awarded to different contractors for boring, stream control work, roads, regulating dam, bridges, dwelling and office, and for the construction of the main dam and dike and subsidiary works at Kent. The last named contract was awarded on May 12, 1921, to Winston & Company, Inc., for the sum of $3,499,925. About four and one-half years is allowed for the execution of this contract, which, according to contract requirements, must be completed in November, 1925. Work was commenced on May 21, 1921, and on August 10, 1922, about 27½ per cent of the estimated total value of the work had been performed.

A diversion channel for the Pawtuxet River, to detour the flow around the site of the deep excavation, was constructed under previous contracts. This consists of a canal about 600 feet long, about 30 feet wide at water level, with a depth of water of about 5 feet, delivering to a horse-shoe type of concrete conduit 21 feet 4 inches high and 25 feet wide, inside dimensions, and about 500 feet long. It was necessary to line the canal with concrete for its entire length on account of the extreme permeability of the soil, which was demonstrated later by the fact that when the water rose above this lining, it seeped through the earth into the main excavation, a distance of from 200 to 700 feet, considerably augmenting the normal seepage.

The contractor started, in June, 1921, the construction of a standard gauge spur line about two miles long to connect the dam site with the New York, New Haven & Hartford Railroad at Jackson, R. I. This involved about 50,000 yards of grading, mostly earth, and the construction of a trestle bridge 500 feet long across the Pawtuxet River. Over this spur has been delivered all the heavy plant and most of the supplies required.

The railroad was completed in about three months and has been equipped with a 54-ton 6-wheel locomotive, seven 34-foot flat cars and one 12-foot flat car.

EMPLOYEES' CAMP

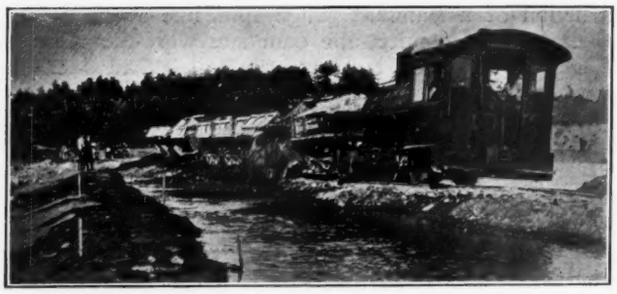
The location of the contractor's camp is downstream from the dam in a broad, rolling field of fairly high elevation overlying sand and gravel strata, affording excellent drainage. The houses have 3, 4 and 5 rooms, are built of wood and covered with building paper. The camp is laid out in streets radiating from the office building, which occupies a prominent elevation from which every house and street in the camp can be viewed. The camp is divided into sections for the foremen, resident families, Negroes, Italians and other nationalities. Many of the Italian families keep boarders.

The census of the camp taken July 1, 1922, showed:

	White	Colored	Total
Males	197	35	232
Females	42	0	42
Children	52	0	52
	291	35	326

In addition to these, there are 109 white males

EXCAVATING DEEPEST PART OF CORE TRENCH, SHOWING CONSTRUCTION TRACK SYSTEM WITH SWITCHBACKS.



DELIVERING SAND AND GRAVEL BY TRAIN INTO COFFERDADM.

who work on the job but who live in the nearby towns.

The camp sanitation is taken care of by the installation of the Kaustine system, by which the sewage is treated chemically in large iron tanks by a solution of caustic soda. The drainage from sinks and wash water runs directly into cesspools excavated in the gravel or sand.

The commissary is centrally located, near the office building, and is prepared to furnish the employees everything in the way of groceries, provisions, meats, house furnishings, clothing, etc. The employees patronize this store at their own volition, as they are under no obligation to trade there if they do not so desire.

The camp is electrically lighted, there being street lights located on poles in the different areas. Most of the houses are electrically illumined. Electricity is paid for by the users, but the company furnishes fuel (coal and wood) throughout the camp, which is included in the rent paid for the cottages.

There is a modern and completely equipped hospital located in the camp area, containing one ward with four beds, one with two beds, a "pest" room, kitchenette for the preparation of diets, an operating room, nurses' living quarters, and general office and waiting room. This hospital is prepared to handle at any time any case that is brought to it for attention, as there is a resident camp physician and surgeon and a graduate nurse available at all hours of the day and night. To partially cover the cost of this department, the employees pay the nominal fee of 25 cents each per week.

The camp is equipped with a laundry, a barber shop, tailor shop, and shoemaker's shop. All the buildings are located at a distance from each other sufficient to reduce the fire hazard to a minimum, and in addition to this precaution there are water line and fire hydrants so located that it is possible to run at least two lines of hose, not over 500 feet long, to any point in the area. This water line is provided with a direct connection to a large supply tank, and in case of fire the domestic supply tank is by-passed and the water has a good pressure derived from the larger tank.

Ice is furnished to the employees living in the camp from three ice houses stocked with ice cut by the company on a lake in the reservoir basin.

Supplies for the camp commissary and boarding houses are secured by a company truck which goes to Providence every day, a distance of about 15 miles. A large part of the small materials and supplies for the work are secured in the same manner, thereby reducing the amount of parts and supplies that it is necessary to keep on hand in the storehouse.

COFFERDAMS

Before beginning work on the dam itself, cofferdams were built both above and below the dam site, the latter being necessitated by the backwater from the mills lower down. These cofferdams are small earth embankments containing about 120,000 yards which was taken from the first material excavated from the dam

DRAGLINE EXCAVATING SUMP.

foundation, and was so selected and placed as to form an acceptable, integral part of the finished dam. The up-stream cofferdam is 50 feet wide on top, the down-stream cofferdam is 25 feet wide on top, and the respective maximum heights are 35 and 15 feet, with slopes of 2:1 on the outside. The loam was stripped from the surface of the ground before building the cofferdam.

PRINCIPAL OPERATIONS

On July 25, 1921, a No. 20 Marion steam shovel commenced excavation for the soil core and on August 5 a second No. 20 Marion steam shovel was installed on the same work. On September 13 a No. 70 Bucyrus steam shovel was installed and on October 17 a second of the same make and size. Stripping of the top soil of the spillway channel was commenced October 31 by a steam shovel, the soil being placed in a storage pile for use in the core construction.

During 1921 there was an average force of 247 men and up to December 17 the principal items accomplished, amounting to about $380,000, were clearing 55.4 acres; grubbing 2.3 acres; removing 22,600 cubic yards of soil; excavation above elevation 195, 81,600 yards; between the elevations 195 and 160, 94,600 yards of earth and 4,400 yards of rock; impervious embankment, 6,260 cubic yards; pervious embankment above elevation 195, 152,500 cubic yards.

EXCAVATING FOR DAM

The main dam and dike construction is essentially a steam shovel job. The excavation of the pit was a serious hazard for most of the competitive bidders, the soil being sand and gravel with large patches of quicksand and heavy de-

posits of large boulders. A maximum depth of excavation of 80 feet to the very irregular surface of granite gneiss formation was required A careful preliminary study of the situation convinced the contractor that the key to the problem lay in the proper sequence and methods of excavation, which eventually developed into a system of flank encroachments on the earth. At first it was proposed to provide preliminary drainage through a progressive series of deep sumps, but the nature of the ground was such that the water did not flow freely in all cases, and the plan was rendered especially difficult by the quicksand beds, of great volume and up to 50 feet in depth.

Early in the operations, a sump was sheeted down to a depth of 25 feet, encountering a large quicksand deposit which gave considerable trouble. A pipe was sunk 10 feet and when it was pulled out, the water followed and boiled out of the hole. Efforts were made for a few days to sink this sump, but the boiling of the quicksand nearly to the top of the pit convinced the contractor that the plan was not feasible, and thereafter the main drainage was effected by the steam shovel cuts themselves, working to a drainage grade.

Two 70-ton Bucyrus shovels were installed, beginning at the west end of the pit, the extreme surface dimensions of which were about 1,000 feet east and west and 130 to 300 feet north and south. The shovels began at the extreme outer edge, working down to their normal lift of 11 feet and proceeding upon opposite sides of the pit, approximately parallel to the longitudinal axis. They moved at a very slight up-grade sufficient to provide drainage back to the starting point, which was effected through a narrow ditch, 3 to 4 feet wide, shoveled out by hand at one side of the cut. Arriving at the end of the pit, the shovel was moved back to the starting point and made another cut alongside, and so on, until the two shovels met in the center of the pit; after which an outside cut was again carried down to a new lower working level and the operations repeated many times until the excavation was completed.

Excavated material was loaded by the shovels into 4-yard dump cars on a 36-inch gauge service track and hauled out of the pit on a causeway having a grade eventually varying from 4 to 8 per cent maximum. Most of this material was placed in the permanent embankments. The total excavation amounted to about 350,000 yards, of which as much as 10,000 yards was boulders of a half-yard or more, one having been encountered that measured 63 cubic yards. All of these boulders were paid for as rock excavation under the terms of the contract. When the quicksand was encountered, the shovels were able to work over it on a bridge of slabs from the contractor's sawmill. The slopes through the quicksand gave some trouble but were controlled by careful operation and a liberal use of gravel and boulder blankets to hold the face.

After the grade of the service track became too steep for profitable operation, the small remainder of the material excavated from the pit and the cleanings of the rock surface were handled

CORE TRENCH, JUNE 1, 1922. STREAM CONTROL CONDUIT AT LEFT BACKGROUND. UP-STREAM COFFERDAM AT THE RIGHT.

in 4-yard skips operated by an 800-foot Lidgerwood traveling cableway, moving on tracks 500 feet long parallel to the axis of the dam. This provided for the very convenient handling of rock, pumping plant, etc., and was found to be adequate, although provision had been made for two cableways. The cableway and the train service suffice for handling most of the material and are supplemented at present by three guyed derricks: one in the pit, one adjacent to it and one in the screening pit—all equipped with 7 x 10-inch American Hoist and Derrick Company's hoisting engines.

The drainage from the shovel cuts was led to a series of open sumps, five in all, only two or three of which were operated simultaneously. These sumps were most advantageously made by the use of two Bucyrus 30-B crawler traction draglines, which opened pits usually 40 to 50 feet in diameter and 10 or 12 feet in depth, the bucket working satisfactorily to the bottom of the pit under the surface of the water. When not engaged in sump work, the draglines were found extremely convenient for cleaning up after the shovels, for shifting the service track in unbroken lengths from one shovel to the other, and for various other services which they could perform with their 40-foot booms equipped with ¾-yard Page buckets.

These draglines excavated with an efficiency probably 60 per cent that of a steam shovel with the same size bucket. When used on straight excavation, they handled about 600 yards in 10 hours each. Under the difficult conditions encountered, each 70-ton shovel handled about 1,000 yards per day of 10 hours, and the monthly excavation in the big pit varied from 20,000 to 37,000 yards. Of course, on short cuts, considerable time was consumed in moving the shovels back and in changing the grade and track.

There was a large flow of clear, cold water into the excavation, which increased gradually with the depth and was intercepted at the various sumps and removed from them by the use of six No. 6 D. S. Volute Cameron centrifugal pumps with 8-inch suction, 6-inch discharge and a maximum lift of 90 feet. These pumps were operated by electricity purchased from the Narragansett Electric Lighting Company. A small steam pump, located in the pit, delivered a large flow of pure, cold water running out of the gravel strata, through a 4-inch pipe under 120 foot head to a stand pipe of 13,000 gallons capacity, which furnished water for the camp. The supply for the boilers and mechanical purposes was pumped direct from the river by a No. 6 D. S. Volute centrifugal pump, electrically driven, which delivered against a head of 150 feet to a 50,000 gallon wood tank which supplied the work through two 6-inch lines, one on each side of the dam. The average amount of water pumped from the pit amounted to about 4,000,000 gallons daily.

DRESSING AND GROUTING BOTTOM

After the irregular rock bottom in the pit had been exposed, it was cleaned up by hand, carefully washed down, barred and wedged to remove loose or decayed rock, and the open seams and big pockets were filled with concrete. A double row of staggered grout holes about 20 feet deep were drilled for the entire length of the dam. These holes started at 2⅝ inches, were reduced in 2-foot sections to 1⅞ inches at the bottom, and were made with Ingersoll-Rand No. 3¼ and No. 4 drills, operated by steam.

The rock was so hard that it was necessary in extreme cases to use as many as eight steels in each 2-foot section, and the average time for making a 20-foot hole was about 10 hours. Two-inch pipes were caulked into these holes and the projecting tops capped, to serve later on for grouting under 10 to 20 pounds pressure, which it is believed will thoroughly close the numerous seams in the rock. After the principal irregularities of the bottom had been concreted, low cut-off or core walls of concrete were built on the surface parallel to the axis of the dam. They were not more than 3 feet high and about 18 inches wide, serving chiefly to intercept any continuous flow of water through the earth embankment that might tend to occur.

EMBANKMENT

The main dam contains a core of soil rolled in 6-inch layers estimated to contain about 600,000 yards of selected top soil and subsoil, stripped from the reservoir basin. The remaining 2,000,000 yards in this embankment is of miscellaneous materials, including sand, gravel and boulders, wet down. The large amount of core material of special quality is stripped by steam shovel from 300 acres or more of the reservoir area, selected as near as possible to the dam. These shovels, all of which have crawler tractions, move freely over the irregular surface and excavate to a depth of from 8 to 36 inches, delivering at first to a spoil bank adjacent to the track system.

Outside of casting distance, the shovels deliver to bottom-dump 2-yard Eagle wagons which are hauled a distance of 200 or 300 feet by mule teams and build the spoil banks to an average height of 10 feet. These banks are generally located in pairs, with a 36-inch gauge track between them, providing for the loading of the soil by a steam shovel to trains that will convey the soil to the dam when building the core. Although this method involves double handling of the earth, it is so simple and so completely avoids delay, that it is considered satisfactory and economical. The material for the outer part of the embankment will be excavated by steam shovels in borrow pits and delivered directly to the embankment. No stripping of the reservoir will be done beyond that necessary to secure material for the soil core.

CHANNEL, SPILLWAY AND BRIDGE

The spillway channel, about 1,800 feet long and 30 feet wide at the bottom, involves an excavation of about 125,000 yards of earth and 20,000 yards of rock. The maximum depth of the cut is 30 feet, which will be generally steam shovel work with some blasting. Channel excavation will be carried on only as the material

can be simultaneously placed in the embankment, thus avoiding rehandling.

The spillway is a concrete structure 413 feet in clear length, about 18 feet high at maximum section and is founded partly on solid rock and partly on earth. From it a channel 1,800 feet long will carry the water back into the Pawtuxet river.

Another principal unit of construction is the highway bridge across a small arm of the reservoir at the spillway. This consists of three reinforced concrete arches, the end arches having a 55-ft. span and the center one a 50-ft. span. The centering consists of timber falsework resting on mud sills. The bridge is being built under a sub-contract by the Briggs Engineering & Construction Company of Providence.

PLANT

The contractors have installed a large and costly plant for the execution of the work with rapidity and efficiency. It includes 2.35 miles of standard gauge track, 15,000 feet of narrow gauge, 10 steam shovels, 4 steam rollers, 6 electric centrifugal pumps, 12 steam pumps, 2 boilers, 10 gasoline and hand pumps, 12 drills, 4 derricks, 5 automobiles, 2 cableways, 2 concrete mixers, 1 grouting machine, a saw mill, air compressor, and miscellaneous equipment. The teams equipment includes 87 mules, 30 dump wagons, 11 dump carts, 3 road wagons, 6 wheel scrapers, stone boats, water wagons, etc. Also 2 riding horses. There is a blacksmith shop for shoeing the stock and repairing wagons, and a machine and repair shop very completely equipped. The machine shop has been found of great service in that it almost wholly eliminates delays for the repair and maintenance of the plant, and with a small amount of spare parts kept in stock, insures the continuous service of steam shovels and other equipment.

The coal bin is quite an important feature. The coal is delivered over the standard-gauge spur track in bottom-dump hopper cars direct to the dumping trestle, which is 30 feet above the ground, where the coal is dumped into bins.

All machinery is operated by steam except the electric pumps, the saw mill and the machine shop. There is also a small portable air compressor plant to operate pneumatic tools and drills. The saw mill has a capacity of 10,000 feet b. m. per day, and has been occupied in sawing up timber cut on the reservoir site, producing rough timber for construction, standard and narrow-gauge ties, rough boards, etc., thus reducing materially the large cost of lumber for the camp and other purposes.

Sand and gravel for concrete are brought in wagons and are handled by a derrick and clamshell bucket to a gravity screen, which separates the sand, gravel and large boulders, delivering directly into 4-yard dump cars on a 36-inch gauge track.

The present force numbers about 340 men, of whom the average number in the large pit is about 15 or 20, excluding the concreting gang. M. J. Look is general manager for the contractor.

The Wanaque Reservoir

The Wanaque reservoir, as described in PUBLIC WORKS for August 27, 1921, is being constructed by the North Jersey Water Supply Commission to furnish a supply of water to Newark, N. J., and other municipalities in the northeastern part of that state. The contract on this work that has been progressing for several months past was for the core wall only of the dam, and that contract has now approached so near completion that Contractor Gahagan is withdrawing his equipment and notified the commission on August 24 that by the end of that month more than $11,000 worth of equipment would have been removed; the reason for this notification being that the contract is being done on the percentage basis, the commission paying a rental for the equipment used.

When the work was started it was proposed to construct a reservoir sufficient to guarantee a yield of 50,000,000 gallons per day. By raising the reservoir 24 feet higher, this quantity can be increased to 96,000,000 gallons, plus 12,000,000 gallons per day which must be allowed to overflow into the river daily to protect the riparian rights of the land owners lower down.

The increase in capacity is being considered because of the probability that 39,000,000 gallons per day will be taken by the three cities of Paterson, Passaic and Clifton. Representatives of these cities last month came to a practical agreement with representatives of Newark, that the latter city would take the same amount, each with the privilege of selling to other communities such portion of its half as it might desire. It was also agreed that of the estimated cost of $16,000,000, the three smaller cities would pay $6,000,000, Newark would pay $7,000,000 because of the longer supply main required to reach that city, and the remaining $3,000,000 would be borne by other municipalities that may apply for a share in the 18,000,000 gallons remaining to be disposed of to other communities by the commission.

Of the total cost the engineers estimated that the reservoir, including gate house, dike, highway relocation, etc., would cost $10,120,000, and aqueduct (of concrete and steel pipe) would cost $5,880,000.

Other North Jersey communities are considering using the Wanaque supply, among these being Kearny, the town council of which a few weeks ago directed and empowered the Mayor and Water Committee to negotiate with the North Jersey Commission for 10,000,000 gallons daily.

Meantime the Lehigh Valley Railroad has won a chancery court suit to enjoin the development of the Wanaque watershed on the ground that the railroad, as lessee of the Morris Canal, would suffer serious injury because of diversion of water from the canal. It is said, however, that this decision of the chancery court will be appealed and that it will not result in any delay in the construction work.

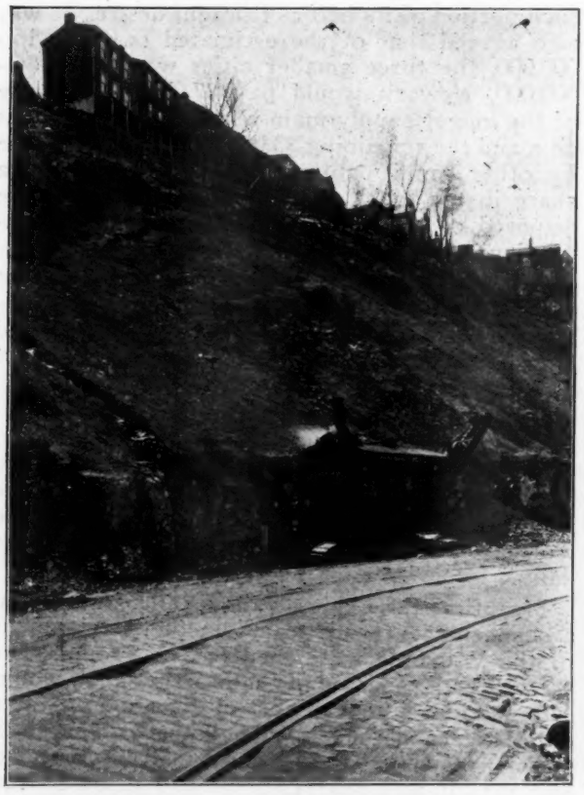
Brownsville Avenue Reconstruction

By Albert N. Dick

Important thoroughfare re-aligned and re-graded, new retaining walls built and old ones strengthened. Roadway made ten feet wider on curves than on tangents. A quarter mile of 9.22 per cent. grade after-regrading

The many hills upon which Pittsburgh, Penn., is built are the chief cause of a number of difficult engineering problems that are continually presenting themselves to the Department of Public Works of that city. Along the south bank of the Monongahela River the hills rise in precipitous bluffs, upon the crests of which are located important residential sections interspersed with a number of small business centers. Stretching out for miles beyond this are a number of boroughs and townships which, though divided into numerous municipal corporations, form in effect one continuous city almost to the Allegheny county line.

A large part of this territory, familiarly called the "South Hills," lies immediately opposite the business section of the city, and the problem of accommodating the ever-increasing traffic between the South Hills and the city is one of growing difficulty. There are several streets leading from the South Hills to the business center, but Brownsville Avenue is probably the most important among them owing to its central location. Its lower or western terminus is about 600 feet east of the Smithfield Street bridge, and the eastern terminus, near the top of the hill, is in a section of the city known as Allentown, at Warrington Avenue which leads directly into West Liberty Boulevard, a fine new highway running to the boroughs of Dormont, Mt. Lebanon, Castle Shannon, etc. The Smithfield Street bridge, only a block from the western terminus of Brownsville Avenue, leads directly into the business section of the city. The importance of the avenue as a means of travel is therefore apparent.



BROWNSVILLE AVENUE, SHOWING OLD PAVEMENT, TRACKS AND SLIDE OF HILLSIDE.

Before the commencement of the present improvement, Brownsville Avenue was poorly paved, with a narrow roadway, steep grades, bad curves and acute angles. It fell 400 feet in a length of 6,000 feet, with a maximum grade of 10 per cent. and 21 angles. Stone walls were constructed along the greater portion of the slope or downhill side of the street to retain the fills, and at certain points there were retaining walls on the hill side to protect the street against slides. These old walls were constructed with a facing of quarry-face stone backed with rubble, all set in mortar. In a number of places they have bulged quite appreciatively from their original position.

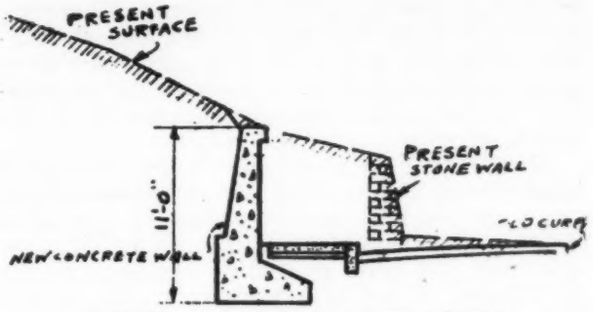
The original paving was cobblestone, which was laid 50 years ago. Some of this had later been removed and replaced with irregular block stone, and some with regular stone block paving.

The abutting property was well built up on the slope side, and at intervals on the hill side also where the topography of the ground admitted of the erection of buildings.

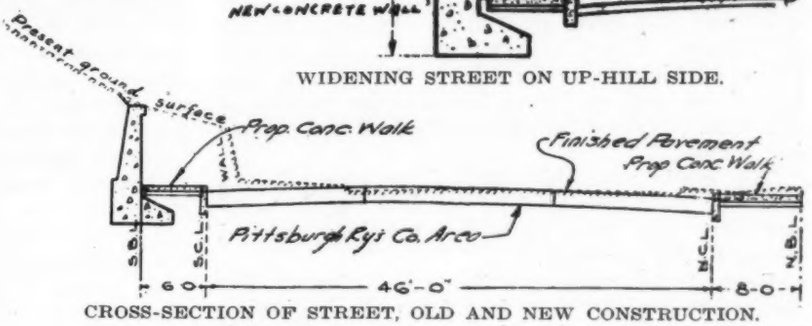
Two lines of trolley tracks were laid some years ago on Brownsville Avenue by the Pittsburgh Railway Company, but on the completion

ABUTTING RESIDENCES AND OLD WALL. Note cracks in wall.

of the tunnel under Mt. Washington all but one line of cars was diverted to this outlet. Owing to the steep grade of the street, derail switches were installed at several points, requiring cars to stop on reaching a switch until the men operating them had closed the derail switch to permit it to proceed. In spite of the presence of these tracks and switches and the bad condition of the pavement, traffic of all kinds and descriptions was quite heavy and the various civic bodies of the South Hills were continually making demands for the improvement of the avenue. The north end of the new Liberty tunnel is located not far from this street and it is expected that the traffic to the city through the tunnels will use Brownsville Avenue at the completion of the tunnel, until such time as the viaduct which will connect up the tunnel with the city shall have been completed.



WIDENING STREET ON UP-HILL SIDE.

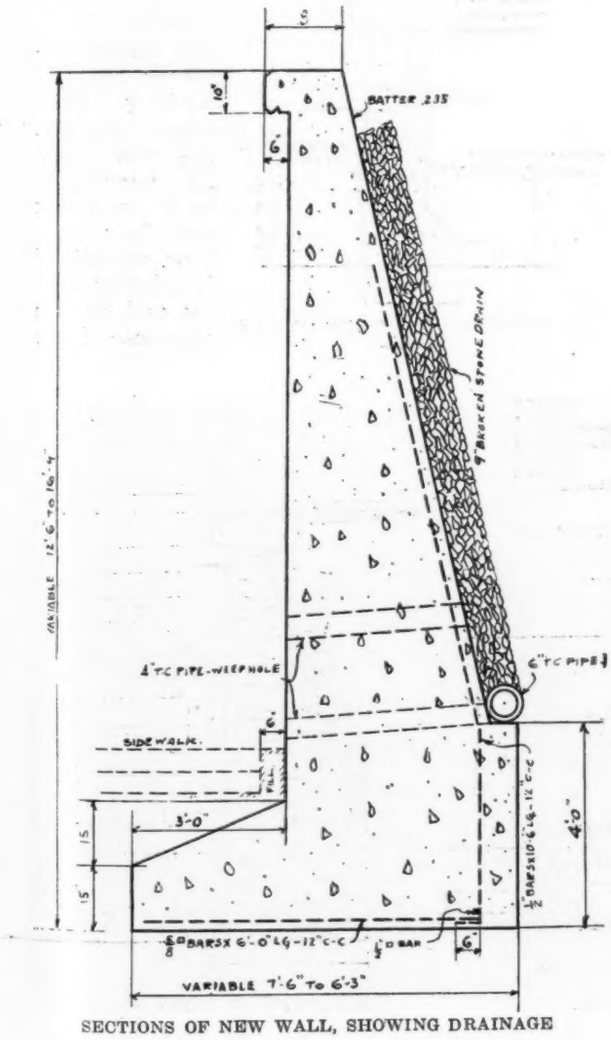


CROSS-SECTION OF STREET, OLD AND NEW CONSTRUCTION.

Because of its increasing importance as a thoroughfare, it was decided to improve Brownsville Avenue and surveys were made, cross sections and contours were taken and a general engineering investigation made with a view to finding the most desirable location for the street conforming as far as practicable with the old lines yet eliminating some of the worst curves and angles, and giving a wider roadway.

There were many dwellings along the line of the street, most of which were occupied by their owners, and because of the acute shortage of houses in the city as well as of the cost, it was deemed necessary to keep the destruction of these houses at a minimum. After an exhaustive study of all the proposed lines, a location was finally decided upon and the necessary legislation enacted.

The preliminaries leading up to this point were very tedious and occupied a great deal of time. Ordinances were prepared and introduced in the City Council, a Board of Viewers appointed, public hearings held, and the whole proposition submitted to the courts for confirmation. With the last legal barrier removed, the city was ready to proceed with the physical work and the contract was let to Booth and Flinn, Ltd., of Pittsburgh, for the sum of $152,500. Work on this contract has not been completed at this writing, but practically all of the grading has been done and all the walls built and it is expected that the paving will be completed in a short time.



SECTIONS OF NEW WALL, SHOWING DRAINAGE

ALIGNMENT AND GRADE

Beginning at the hill top or eastern end of the street (although as a matter of fact it runs for a distance almost due east before turning into its general westward direction) the street has been widened from 50 feet to 60 feet with a 10-foot sidewalk on the slope side and a 6-foot walk on the hill side. About 1,100 feet from the starting point the line turns to the left by a series of curves, first compounding and then reversing to the right and the left, making four curves; the P. T. of the final curve being about 1,300 feet from the first P. C.

The curb lines of the terminal curves are nonconcentric but are so arranged as to widen both

street and roadway on the smaller radii curves, beginning at the first P. C. with a 36-foot roadway, widening this to 46 feet and reducing it again at the final P. C. to 36 feet. Some property was taken along the curves to permit of this widening, mostly from the hill side.

Walls were built along the hill side varying in height from 12 feet to 17 feet. At one point a small curtain wall was necessary on the slope side, this wall being built outside of an old stone wall that had been erected on the lines of the old street. Open-joint terracotta pipe, broken stone backing extending from the pipe to the top of the wall, and weep holes at the bottom of the wall, provided for drainage of all the retaining walls.

The grade over this part of the street began at 6 per cent., changed by vertical curve to 3.5 per cent. and then again by another vertical curve to 7.4 per cent.

Beyond the curve the line runs almost due west. At a point 2,650 feet from the beginning there is another series of curves, first to the left and then to the right and again to the left. Here again the roadway is widened, reaching 41 feet on the central curve and again reducing to 36 feet at the final P. T. Property was taken on this section of the street on the hill side which required the removal, razing or alteration of a number of houses. The grade over this section changed to 5.25 per cent.

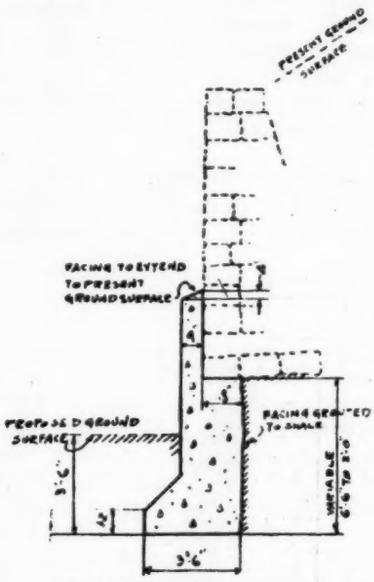
At about 4,200 feet from the beginning the grade changes to 9.22 per cent., at which it continues to the end of the street. The roadway on the final tangent is 34 feet wide, with 10-foot and 8-foot sidewalks on the slope side and hill side respectively.

CONSTRUCTION

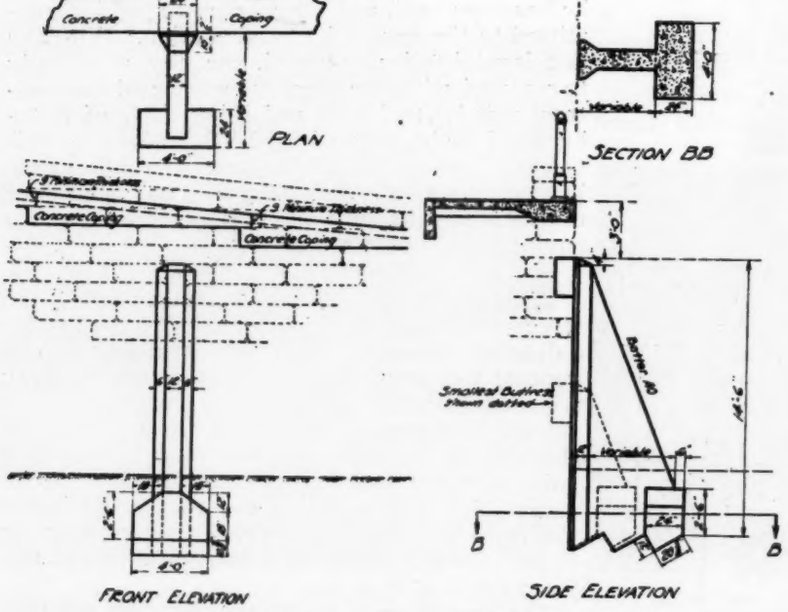
The retaining wall work was varied at different points to meet the different conditions. At one place an old stone wall was strengthened by building concrete buttresses and installing a concrete coping. At other points concrete walls, both plain and reinforced, were built; also one wall of cyclopean masonry, the stone used in this being taken from old stone walls. In the cyclopean masonry the contractor was required to lay the stones horizontal with at least 6 inches of concrete on all sides of each stone.

The pavement is ordinary Ligonier stone block set on an 8-inch concrete base, the joints filled with portland cement grout. The curbs are of concrete protected with 3 x 2 x ⅜-inch angles on the exposed edge and set in a trench on one foot of broken stone drain which is connected to catch basins.

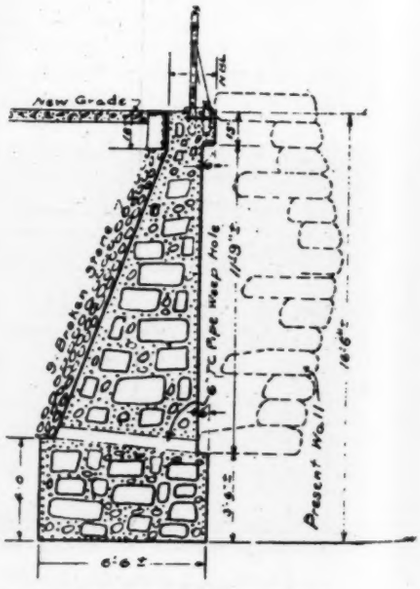
One car track is left extending the entire length of the street and the pavement between the rails is of the same character as the balance of the road. The rails are 9-inch Trilby supported by wooden ties, the spaces between the ties being filled with concrete. All the work in connection with the track and for one foot outside of it is being done by and at the expense of the



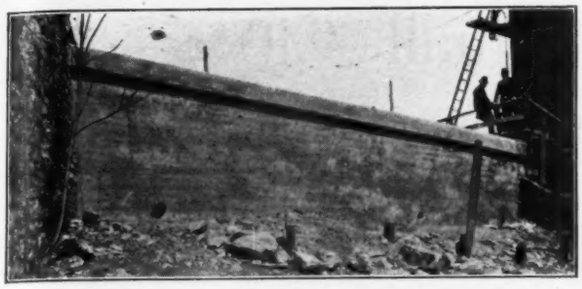
METHOD OF UNDERPINNING WALL.



DETAILS OF BUTTRESS FOR OLD MASONRY WALL.



REPLACING BULGED WALL.



SECTION OF NEW WALL ON DOWN-HILL SIDE.

Pittsburgh Railway Company. The work was constantly under the supervision of the city and many tests were made of the materials entering into its construction.

Excavation was done by means of two No. 28 Marion shovels. The earth not needed for grading was removed by large motor trucks. The wall trenches were excavated by a steam auto crane using a half-yard clam-shell bucket, the same machine being used with a dump bucket for pouring the concrete into the forms.

The concrete was mixed in proportion of 1 cement, 2½ sand and 5 gravel. A Rex paver was used in mixing the concrete, chuting the concrete directly onto the finished subgrade for the pavement base, and into the curb forms for the curbs. No concrete was poured during freezing weather.

The contract called for the following items:

18,000 cu. yds. grading at	$0.90
1,050 cu. yds. trench excavation at	2.50
15,340 sq. yds. block stone on 8-in. founda. concrete	4.85
10,500 lin. ft. protected concrete curb	.90
171 lin. ft. protected concrete radius curb	1.60
300 sq. ft. granite crossing	1.25
54,000 sq. ft. concrete sidewalk	.20
28 catch basins	80.00
390 lin. ft. terra cotta pipe sewer	3.00
1,065 cu. yds. concrete in retaining walls	16.00
78 cu. yds. concrete in buttresses	20.00

and 14 other items.

OLD RETAINING WALL; NEW WALL AT LEFT.

The work was under the supervision of Charles A. Finley, Director of Public Works; Charles M. Reppert, Chief Engineer; Tom M. Reed and Samuel Eckles, Assistant Chief Engineers; and Antes M. Snyder, Construction Engineer.

Specifications for Pressure Water Filters

The associated manufacturers of water purification equipment has adopted certain standards for pressure water filters, these fixing the capacities of filter and construction details of both steel and cast iron pressure filters.

The rates of filtration should conform to the following schedule: Two gallons per square foot per minute for all supplies used for drinking or for the preparation of food products. Two to 4 gallons per square foot per minute when filtering a treated municipal supply of approved bacterial purity. Two to 4 gallons per square foot per minute for swimming pools and for all industrial uses.

Two to 5 gallons per square foot per minute as conditions may warrant for double filtration, using sand followed by charcoal where reduction of color, odor, taste or certain forms of iron is desired. This method of filtration not to be applied for bacterial purification.

A table is given showing the capacity of filters of different diameters from 1 foot up to 8 feet for the vertical filters and of 8 feet cylinders with lengths between 10 feet to 25 feet for the horizontal filters; also the size of pipe connection for filter wash and for waste to sewer and the amount of wash water required at 12 gallons per square foot per minute. The inlet outlet filter waste pipes for vertical filters range in size from ¾" for a 12" cylinder to 5" for an 8 foot cylinder, while the sewer waste pipes vary from 1" to 6". The wash water varies from 9.42 gallons to 600 gallons. The horizontal filters, which have larger capacities, have filtered wash pipes of 6" to 8" diameter and waste pipes of 8" to 10", while the wash water varies from a minimum of 822 gallons for a 10 foot filter to 2,157 gallons for a 25 foot filter.

The filter shells are calculated for working pressures of 65 lbs., 100 lbs. or 125 lbs. per square inch, the thickness for each and for each of several diameters being given in tabular form; the calculation having been based upon strength of steel plates between 55,000 and 65,000 lbs. per square inch. The radius of the dished heads is the diameter of the tank. The tanks are to be given a hydrostatic test 50% in excess of the working pressure. Cast iron filters are not designed for pressures higher than 100 lbs.

Sanitating a Small City

By W. A. Hardenbergh*

A model health code and compulsory immediate construction of septic closets required in small suburb of Birmingham. Details of closet construction.

In carrying out the sanitation program of the Jefferson county (Alabama) Board of Health, various problems have been encountered in several of the small cities and towns. These problems and the methods employed in solving them may be of interest to the many other places of similar size in the country which are confronted with the problem of improving their sanitary conditions without too great an expenditure of money.

Between April and November, 1921, Leeds, Ala., suffered twenty-four cases of typhoid fever. In the beginning of 1922, there was another flare-up, twelve cases developing in January and February. These out-of-season cases merely illustrate the ideal conditions for disease that existed in Leeds. While many of the wells were in fairly good shape, there was scarcely a sanitary toilet in the place. Open-back privies and open wells were found almost side by side. During every rain, the surface water carried pollution from these insanitary toilets all over town. No piped water was available, nor was there more than a slight hope that it would be available within the next few years. If water had been available, the cost of constructing sewers would have been almost prohibitive, as well on account of the large amount of rock excavation as because of the fact that Leeds lies on the watershed of one of the main sources of Birmingham's water supply, and the sewage would have to be given very complete treatment or pumped out of the water-shed.

The county board of health recommended the adoption of a model health code which provided for the elimination of surface toilets and their replacement by septic closets. Future installation of a municipal water supply was provided for, and requirements made for connections to the mains. Immediate installation of the specified toilets was required, and the municipality was authorized to construct toilets where householders neglected to comply with the law, the cost of such construction to become a lien upon the property.

There was considerable opposition to this program among the 3,000 inhabitants of the town, but it is gratifying to note that this has almost entirely disappeared since the work has begun.

Septic closets were specified because of the possibility of their later use as septic tanks, and because no other privy seemed to fill the requirements. Pits are dangerous in limestone formations, such as are found at Leeds; experience has shown that the box and can toilet is not suitable for small town use; neither the concrete vault nor the chemical toilet were deemed suited to this installation.

The Alabama law gives to incorporated towns and cities of this size police jurisdiction for a distance of one and one-half miles beyond the city limits. Within the town proper and the police jurisdiction, were 450 homes, about 100 of which were the property of the Atlas Portland Cement Co., which operates a plant at Leeds.

In designing the tanks to be used in connection with the septic closets, several points were observed. These included the later use of the tank as a septic tank, ease and cheapness of construction, ability to operate under abuse and without much attention, and as great standardization as possible. Sub-surface disposal of the tank effluent was adopted.

As before noted, sewers will not be available for a long time, but running water may soon be. The septic closet tanks were designed large enough to handle the sewage from the average home, so that with water and a flush toilet, the house sewer can be connected to the septic tank, thus giving each home an individual treatment plant. With this idea in mind, elbows were placed in most of the tanks to simplify connections to the house sewers.

It was decided that construction economies effected by the use of only two sizes of tanks would be greater than any extra costs from the use of too large tanks. The two sizes adopted were 270-gallon, for not more than 10 people, and 600-gallon, for not more than 25 people. Except in the case of sewage from the cement plant, no tanks larger than 600 gallons have been required. These sizes are ample for use either as septic closet or septic tank.

Especial attention was paid to reducing the cost of construction. The use of wood baffles allowed the use of a simple, knock-down box form which was more lasting, easier to build, and much easier to take down than the old-style form used in casting tank and concrete baffles at one operation. The life of the wood baffle is really unimportant, for outlets dropping about 14 inches perform practically all the functions of the baffle.

600-GALLON COMBINED SEPTIC CLOSET AND SEPTIC TANK, WITH SEAT RISER AND MANHOLE FORM IN PLACE.

* Sanitary engineer, Board of Health, Jefferson County, Ala.

About $6 per tank represents the saving on the 270-gallon tank by the use of the wood baffles. Forms have been used more than 20 times, but the average life is about 15 times. The life of the old-style form does not generally exceed 5 or 6 tanks. The cost of building the form for the small tank is about $5.

Generous capacity and education are the only means of reducing trouble in septic closets. Both of these have been provided for.

The 270-gallon tanks were originally designed to be built complete for $20. The first few cost about $18 each. These were satisfactory, but additional details approved by the city officials raised this cost. The present actual cost is about $23, but the town charges $25.85 to cover overhead and depreciation of equipment used in the work.

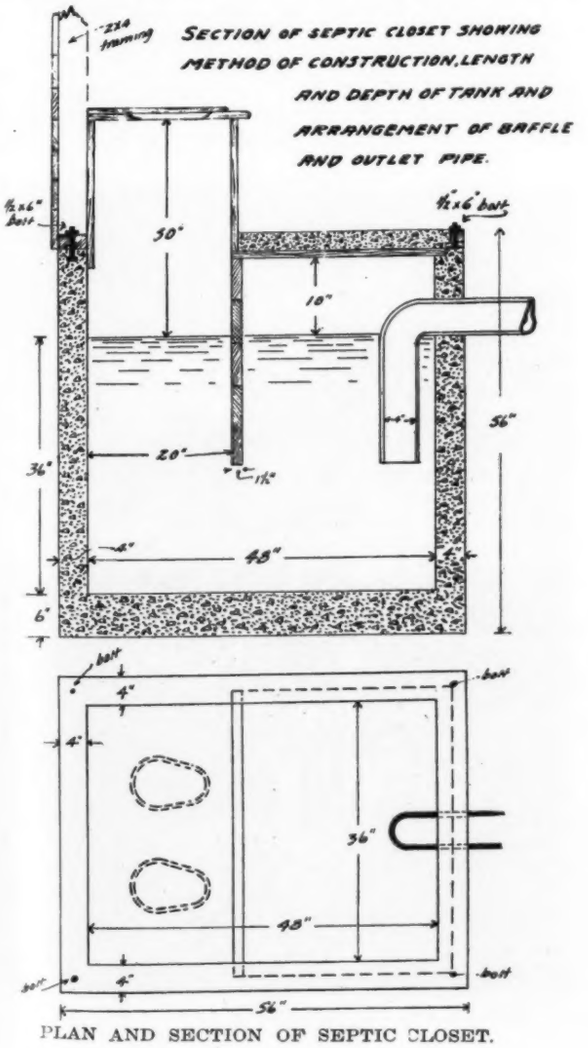
Construction is almost entirely by city forces. A small gang hired by the city does the work. Material is bought and paid for by the city, which furnishes the gang all equipment, charging the property owner for the work. The house owner is free to build his own tank if desired, and some few have done so, but municipal construction is generally cheaper. At first the practice was to pro-rate the actual cost on 10 toilets, assessing one-tenth of the total against each of the 10 owners benefited. A standard charge, found by experience to be fair, but adequate, is now made for each tank. The charge is given itemized in the following table, each item including approximately 10 per cent. for depreciation and overhead.

Digging the hole	$1.00
Placing the forms, and rental for same	2.00
Two barrels of cement	4.70
Broken stone and stone dust	4.00
Mixing and pouring concrete	2.55
Removing forms	1.50
Filling tank with water and testing	1.00
Constructing seat riser, including material	2.25
Tile, sub-surface line and elbow	3.65
Laying tile line	1.00
Finishing tank and placing privy house	2.20
Total charge	$25.85

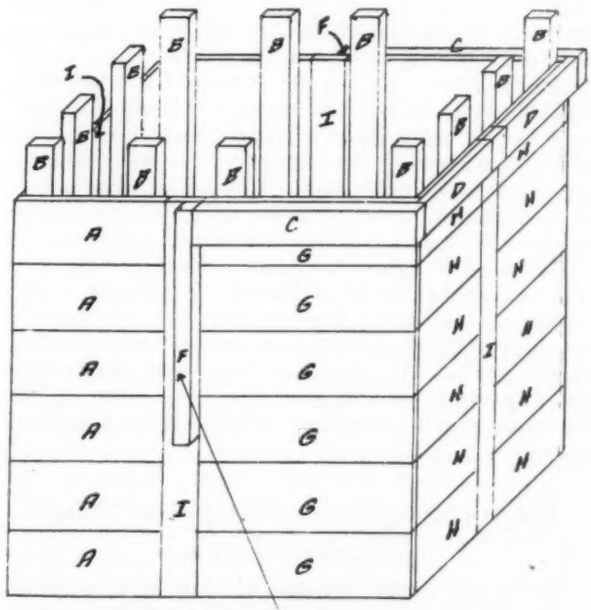
When desired, new privy houses are built. The charge for these averages $17, of which $11 is for material and $6 for labor. The charge of $25.85 covers ordinary repairs to and remodeling of the old privy house.

Labor is paid 17½ cents, and foremen 50 cents per hour. The cement plant at Leeds furnishes the cement at $2.35 per barrel and run of the crusher limestone for $1.35 per ton. At first gravel was used for concrete, but the crushed limestone was found to be so much better that it is now used exclusively. About 5 parts of this, which varies from dust to half-inch pieces, is mixed with 1 part of cement. The resulting mixture is a very fine grade of concrete that sets up rapidly, thus releasing forms promptly. Leaky tanks average about one in five with gravel; with the lime rock the average is about one in 15 or 20.

Water for mixing concrete and filling the tanks has to be hauled from a nearby creek. This consti-



PLAN AND SECTION OF SEPTIC CLOSET.



INSIDE FORM FOR SEPTIC CLOSET.

Lumber required: A—12 pieces 1x8x18; B—12 pieces 2x4x54; C—2 pieces 2x4x28; D—2 pieces 2x4x17; E—1 piece 2x4x4; F—2 pieces 2x2x30; G—12 pieces 1x8x26; H—24 pieces 1x8x16; I—4 pieces 1x4x48; top forms—5 pieces 2x8x30; baffle—5 pieces 2x6x40.

Concrete materials required: 8 sacks portland cement; ½ cu. yd. sand; 1 cu. yd. broken stone or gravel; 4 bolts ½x6 in.

tutes quite a charge, but is the best means available. A Fordson tractor and a trailer are used for most of the hauling.

Items in reducing the cost included the fact that work was started at one end of town and carried through quite uniformly. The personality of the construction foreman and his ability to find short cuts and simple ways of doing things was still more important. It was found cheaper to maintain one building gang of 8 men, with a sub-foreman in charge of privy house construction then to expand the work too rapidly. With fair weather, 60 to 80 tanks per month are built. The cement plant is building its own tanks, but after the same designs as used by the city.

Just after the work of sanitation was started, a hookworm survey of the school children was made. This showed only 15 per cent. of the pupils infected with hookworms or other intestinal parasites. It will be interesting to note, by means of a similar survey in one or two years, the reduction accomplished by sanitation; it will also be interesting to note the agreement in reduction of the filth-borne diseases and of intestinal parasites.

A campaign is now being started to educate the people of Leeds in the use of septic closets and septic tanks, in the hope that trouble along this line can be materially reduced, if not eliminated. A whole time sanitary officer is provided by the city to aid in the work. The campaign will include lectures, personal talks, training of the sanitary inspector and instruction by the nurse stationed at Leeds.

The financial aspects of the installation of septic closets are interesting. An installation of sewers for the town, including either a complete purification plant, or a pumping station and long pipe line, would have cost probably $40,000—an accurate estimate is impossible because of the unknown amount of rock excavation. In addition there would have been the immediate cost of a water system. The septic closets represent a cost of about $10,000, to which should be added about $4,000 for repairs to old and construction of new privy houses. The septic closets can be converted to septic tanks by laying additional tile sub-surface drains at a cost of about $6 per tank.

The work at Leeds has been carried on under the direction of the Board of Health of Jefferson county, Dr. J. D. Dowling, Health Officer. J. M. Spruiell is mayor of Leeds, and James Poe, general foreman of the work. The design of the septic closets and the supervision of the work has been done by the writer as sanitary engineer of the county board of health.

Engineering Societies Oppose State Licensing Laws

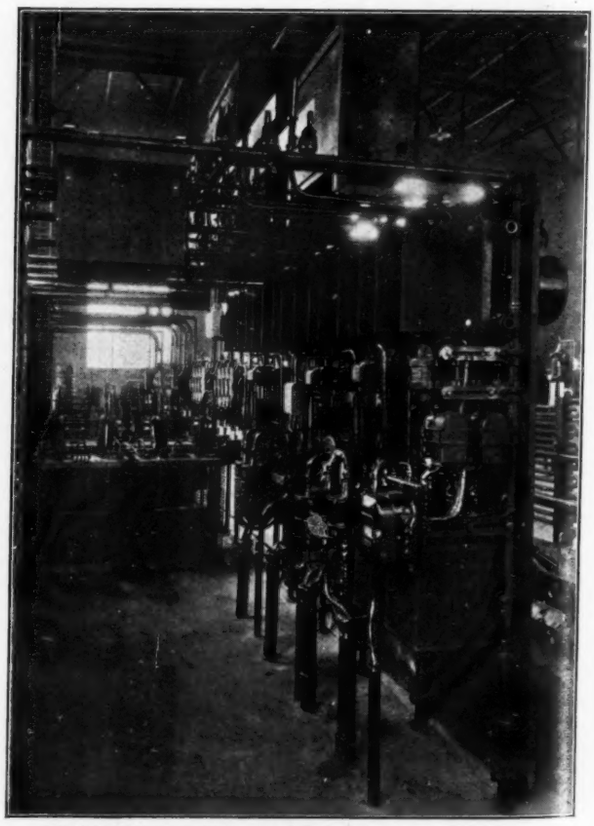
While the American Association of Engineers has been the most active agent in securing the adoption of laws licensing engineers in the various states, several other engineering societies both national and local have opposed such laws. In Massachusets and probably some of the other states the opposition of these engineering organizations undoubtedly prevented the passing of licensing laws that had been introduced in the state Legislature.

Recently in New York and Pennsylvania, both of which have adopted such laws, that in Pennsylvania having just gone into effect and that in New York going into effect next year, local sections of the American Institute of Mining Engineers have started movements for repealing the laws. In Pennsylvania the movement is also endorsed by the Engineering Society of Northeastern Pennsylvania. In Pennsylvania a test case under the licensing law is now in the courts If the law is upheld, an effort will be made to have it repealed at the next session of the Legislature.

Lima's New Street Lighting

Newly installed system of street lighting, 1,245 light units being placed on sixteen miles of streets. Candle-power, height and spacing varied to meet requirements of each street.

The city of Lima, Ohio, has just completed a new ornamental street lighting system at cost of about $200,000 which comprises 1,245 lighting units and extends over 16.2 miles of street, covering the entire downtown business section and four of the principal residence streets. The



REGULATING TRANSFORMERS AT CITY PUMPING STATION, LIMA.

WEST HIGH STREET, LIMA, O. 400 C. P. LAMPS WITH AUTO TRANSFORMERS, 50 FEET SPACING.

officials believe that this is the most complete and up-to-date system of the kind in the country. Plans and specifications were drawn by Herman Gamper, of Columbus, Ohio.

The installation includes underground wiring and ornamental posts, the current being furnished by a turbo-generator equipment in the municipal pumping station through constant current 6.6 ampere regulating transformers.

One of the most interesting features of the new installation is the graduation of candle power, mounting height and spacing in accordance with the requirements of the individual streets. In the public square the posts are 15 feet high with 1,000 candle power lamps and special refractors that throw the light toward the center of the square. On the main business streets they are 13 feet 3 inches high and carry 400 c. p. lamps. On the minor business streets and in the resident sections the posts are 12 feet 3 inches high and carry 250 c. p. lamps.

In the downtown business section the standards are spaced 50 feet apart but throughout the balance of the system the spacing is 100 feet. In order to obtain the desirable uniform distribution, the Director of Public Service, Elmer McLain, took a firm stand against the request of individual owners for changes in locations of lamps and insisted that each one should go exactly where planned. The result is an unusually uniform distribution of illumination.

It was considered by the consulting engineer to be poor economy to save by cutting down the candle power of the lamps, for this saving is very small as compared with the initial outlay for the installation; but the candle power was used that was thought to be most effective. The consumption during December, 1921, the month of longest nights, was 57,000 k. w. h.

The posts used were the Westinghouse-Cutler Continental post equipped with Sol-lux tops and Monax diffusing glassware. The lamps for 400 candle power and upwards are operated through auto transformers in the capitals of the posts and the 250 c. p. lamps are equipped with Regent C. repeating film sockets. Hazard steel-taped lead-covered cable was used for the underground system and single-conductor rubber-covered and braided cable for the post wiring. The system is divided into 10 circuits. Two of these, which extend throughout the system, include street intersections and the intervals between, and alley intersections, and are on all night. The remaining circuits are turned off at midnight. A disconnecting pothead is installed in the base of each post which, if the post should be accidentally broken, automatically disconnects the broken post, short circuits the line and leaves the rest of the lamps burning.

The alley intersections are provided with special brackets attached to the corners of the buildings and equipped with radial bowl street hoods and operated from the underground system through safety coils. By this new installation the necessity for unsightly overhead pole line equipment has been eliminated, thus adding greatly to the appearance of the street.

The contract for the construction work was let to the Northern Electric Company of Columbus, Ohio, after lively competition among about fifteen bidders.

Activated Sludge in England

According to a recent report of the Minister of Health of England, considerable progress was made last year in establishing the activated sludge treatment of sewage in that country. Experiments have been carried out at Sheffield, Manchester, Birmingham, Stoke-on-Trent, Reading and other places. Sheffield, after running a plant dealing with 1,000,000 gallons of sewage a day for more than 12 months, decided to adopt this for the whole of its sewage and a new plant is already under construction. Agitation of the sludge both mechanically and by air blowing have been tried and both have given good effluents; but the former, which is in operation at Sheffield, gives a lower cost of installation and the works are more easily maintained than with air blowing. In addition to Sheffield, activated sludge has been adopted at Stoke-on-Trent, Reading, Rotherham and East Ham.

Water Mains and Meters in St. Louis

Electrolysis troubles with 36-inch steel main and with cast iron pipe. Twelve miles of pipe cleaned. Cost of setting, maintaining and reading meters. Average and maximum consumption figures for fifty years past.

DISTRIBUTION SYSTEM

Considerable trouble has been experienced with a 36-inch steel pipe due to electrolysis. Last year this line had to be taken out of service on two occasions because of leaks so caused. During the first withdrawal from service two holes which had been plugged with wood the year before had to be repaired. The second shutdown was made necessary by a leak under the car tracks in Broadway, which proved to have been caused by the worst of a serious cluster of pits spread over a length of 30 feet of main. The United Railways spot welded these holes and pits as they had done on previous occasions, and in order to prevent a reoccurrence of the trouble, bonded the rail to a saddle-shaped plate welded on to the pipe.

It is a question with the Water Department whether the increase in number of bonds between the rails and the steel line is not endangering the cast iron system by inducing an increased flow of current at points where it is close to the steel line. Efforts at present are being confined largely to minimizing the amount of damage that can occur during the next few years, since it is the policy of the United Railways to substitute a number of automatic substations supplying small areas for the larger power houses, five of the small sub-stations being already under construction. This substitution of the small stations for the large power houses will automatically solve the electrolysis system by keeping the voltage drop between each station and the farthest point in its area low enough to prevent the leaping of current from the rails to underground structure.

That the problem is a serious one is indicated by the fact that duing the last fiscal year the Water Department spent $1,830 for replacing cast iron pipe at five points which had been destroyed by electrolysis and for uncovering the steel main at three points for the railway company to repair by welding.

Since 1908 the National Water Main Cleaning Company has been carrying out a contract for cleaning the mains of the city and during the past fiscal year completed a contract which included 195 miles of mains. Last year's cleaning included nearly 5 miles of 12-inch pipe, about 3 miles of 30-inch, and 4 miles of 36-inch. Three stretches of 12-inch pipe were tested before cleaning and after cleaning and the efficiencies of flow were found to have increased from 66% to 97%, 62% to 95%, and 74% to 98% respectively; while a 36-inch length that was tested was found to have increased in efficiency from 67% to 98%. From the twelve miles of pipe cleaned there was removed 415 tons of incrustation or 12,114 cubic feet.

It has been found that the inner coating of pipe has sometimes been very noticeably scratched by the blades of the cleaning machine and the supposition is that this will cause a more rapid deterioriation of the pipe after cleaning than after the original laying. In order to obtain data on this point, flow tests have been made periodically on three of the lines cleaned in 1920, one of these being a 20-inch main and the other two being 6-inch mains. The 6-inch mains showed a falling off in efficiency from an average of 95% to an average of 71% in six months after being cleaned, and in two years the efficiency had fallen to an average of about 64%. The 20-inch main retained its high efficiency much longer, the efficiency having fallen from 96% to 90% in two years and five months. These efficiencies were obtained by measurements made with the pitometer. This work will be continued with a view to obtaining more definite and long-period knowledge on the subject.

METERS

The city has in use 9,545 meters, about half of which are 5/8" meters, while the total number of services is 121,019. The number of connections metered has increased during the past ten years from 6.6% to 7.7%.

Each year for the past eight years a certain number of meters have been condemned, presumably because of serious damage or incorrect registration. The number condemned each year has varied from a maximum of 4.8% to a minimum of 1.7% of the total number in service. The number condemned last year was 225, or 2.3% of the total.

The cost of maintaining the meters last year was $17,945, or an average of $1.89 per meter. The total comprised the salaries of six meter men and two repairmen, one man testing, and clerks, which totaled to $12,600; $2,458 for meter repair parts, and the balance for feed and bedding, shoeing and clipping horses, wagon repairs, auto supplies, printing and incidentals.

Reading meters cost $14,582, or an overage of $1.53 per meter, this total comprising $12,672 for meter readers' salaries and $1,910 for the maintenance of 5 Ford cars. The meters are read at least once a month, some of the large ones being read weekly. These readings are made by 8 men who use automobiles, two men in each machine, who also make inspections and report leaks on metered premises as they make their rounds. With a larger percentage of the services metered, the cost of maintenance would be less. In discussing this matter the Water Commissioner, Edward E. Wall, estimates the cost of the annual maintenance of 110,000 meters at $44,000.

During the year, 282 meters were installed and 113 were removed, giving a net increase of 169 meters. The meters are set by the contract method which has proved very satisfactory and will be continued. The cost of setting meters under this plan,

excluding the boxes, was $4.50 each for 5/8" and 3/4" meters, $5.00 for 1" meters, $5.50 for 1½" and $6.00 for 2".

Commissioner Wall, in his annual report on the work and needs of the Department, states reasons for concluding that it would not be economical at the present time to place meters on all connections in St. Louis. Referring to figures which he presented showing the rates in a number of cities throughout the country together with the percentage of services metered in each, he says: "It could hardly be expected to reduce the water consumption in St. Louis by more than 20,000,000 gallons per day, which would reduce the average daily per capita to little more than 100 gallons, since the average for 40 cities having 80% or more of their services metered is 105.4 gallons, while the average of the 18 highest out of the 40 is 113 gallons.

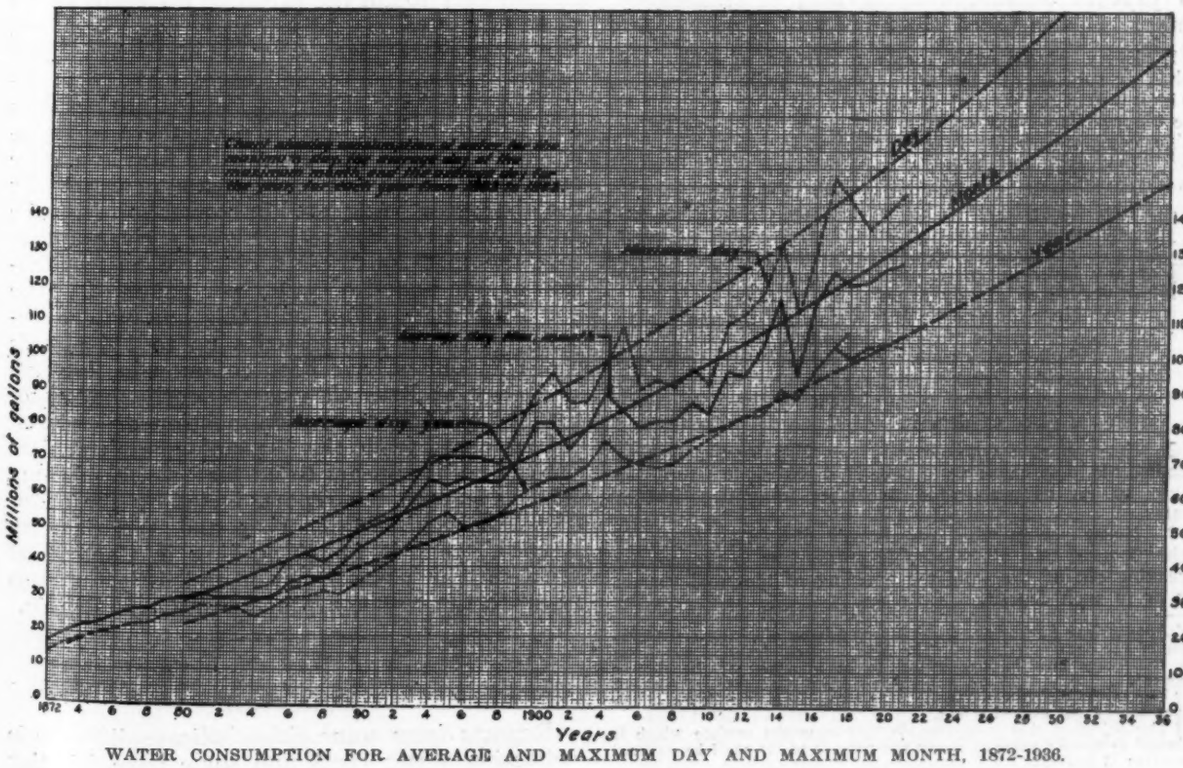
"Twenty million gallons of water saved per day amounts to 7,300 millions per year, a little less than one-fifth of the total pumping. The reduction in the cost of operating and maintaining the water works brought about by this lowering of the consumption would come through the saving in coal, chemicals and other supplies. There would doubtless be a slight decrease in the item of labor, but not by any means proportionate to the reduction in quantity of water pumped. The cost of coal per million gallons pumped in 1920-21 was $4.50, of chemicals $8.29, to which if we add one-tenth of the cost of labor for purification and pumping 1,000,000 gallons ($.81) we will have a total of $13.60." Other slight reductions might bring the saving to $15.00 per million gallons or $109,500 a year.

To meter all the remaining services in St. Louis would cost more than $2,000,000, the interest on this would be $80,000, the maintenance is estimated at $44,000 and the depreciation at $60,000, making a total of $184,000, which is $74,000 more than the value of the water that would be saved annually.

If, however, by metering the city could postpone for a number of years the expenditure of the millions of dollars that will be required for enlarging the plant, metering would still show financial justification, and had St. Louis begun installing meters ten years ago, as was recommended by the Commissioner, the new works that are now imperative would not have been needed before 1937. As it is, however, the existing works will have reached the limit of their economical service before 110,000 meters could be installed, and reduction in consumption effected by complete metering would come too late to permit postponing the building of the new works.

Commissioner Wall's opinion as to metering is expressed as follows:

"Because the figures at hand do not prove conclusively that a handsome profit would at once accrue to the city through the general installation of meters, it does not follow that placing meters on practically all services is undesirable or unwise. In fact, the only valid reason which can at present be adduced against meters is the prevailing high prices. As soon as it appears that prices have become adjusted to after-war conditions, the city should adopt and carry out the policy of selling water by measurement, just as gas and electricity are sold. The principal reason why this should be done is that it is the only equitable method by which any measurable service should be supplied to the public. By this means each consumer pays only for the water he receives but no more. The only logical explanation of the opposition to water meters is that the objectors feel that under flat rates they do not pay for all the water used and wasted. All other argu-



WATER CONSUMPTION FOR AVERAGE AND MAXIMUM DAY AND MAXIMUM MONTH, 1872-1936.

ments, such as those based on sanitary reasons, the plea that lawns would go unwatered, and the fear that tenants will waste water to revenge themselves on the heartless landlords, have been proven to be without foundation in the many cities and towns whose water supplies are fully metered.

PERIODIC CONSUMPTION DATA

The accompanying diagram shows the consumption from 1872 to 1921 inclusive, giving the average daily consumption for each year, the average day for the maximum month of each year and the maximum day of each year. Through each of these sets of records a curve has been drawn and continued to the year of 1936. It is estimated from these records that 150,000,000 gallons a day represents an average daily capacity for the maximum month and that the capacity required for the maximum day is 20 per cent greater than that required for the maximum month, while the capacity required for the average day is .8 that required for the maximum month; or, taking the average for the year as the unit, the average day of the maximum month is 25 per cent greater and the maximum day of the year 50 per cent greater.

Precautions in Dumping Refuse

The Ministry of Health of London, England, has, under date of July 26, issued a "list of precautionary measures for abating and preventing nuisances arising from refuse tips" which it considers to be necessary for all tips or dumps throughout the country. The principal object is to prevent nuisances from fire, rats, flies or smells. These precautions are as follows:

1. Every person who forms a deposit of filth, dust ashes, or rubbish, of such a nature as is likely to give rise to nuisance, exceeding * cubic yards must, in addition to the observance of any other requirements which are applicable, comply with the following rules:—
   (1) The deposit to be made in layers;
   (2) No layer to exceed † feet in depth;
   (3) Each layer to be covered, on all surfaces exposed to the air, with at least 9-in. of earth or other suitable substance, provided that during the formation of any layer not more than * square yards may be left uncovered at any one time;
   (4) No refuse to be left uncovered for more than 72 hours from the time of deposit;‡
   (5) Sufficient screens or other suitable apparatus to be provided, where necessary, to prevent any paper or other *debris* from being blown by the wind away from the place of deposit.

2. Every person who deposits any filth, dust, ashes, or rubbish likely to cause a nuisance if deposited in any water must, so far as practicable, avoid its being deposited in water.

3. Every person who deposits any filth, dust, ashes, or rubbish, must take all reasonable precautions to prevent the breaking out of fires and the breeding of flies and vermin on or in such deposit.

4. If the material deposited at any one time consists entirely or mainly of fish, animal or other organic refuse, the person making such deposit must forthwith cover it with earth or other equally suitable substance at least 2 ft. in depth.

5. Every person who deposits any filth, dust, ashes, or rubbish must take all practicable steps to secure that tins or other vessels or loose *debris* likely to give rise to nuisance are not deposited in an exposed condition on or about the place of deposit.

6. Sufficient and competent labor must be provided in connection with the deposit to enable the necessary measures to be taken for the prevention of nuisance.

7. So far as practicable each layer of refuse which has been laid and covered with soil must be allowed to settle before the next layer is added.

8. Wherever practicable the person making the deposit must avoid raising the surface of the tip above the general level of the adjoining ground.

9. All refuse must be disposed of with such dispatch and be so protected during transit as to avoid risk of nuisance.

* Appropriate figures should be inserted here, after full consideration of the local conditions. The Ministry will be glad to advise on this point and, in any event, to be informed of the figures adopted.

† Unless the circumstances are very exceptional, the depth of the layer should not exceed 6 feet.

‡ The object of this is to provide that even the surface which is allowed to remain exposed under the proviso to (3) shall be covered up after 72 hours.

Refuse Disposal in Europe

A committee from Glascow, Scotland, made a trip through the Continent last Fall to gather information on methods of dealing with house refuse, but the result of their visit was not made public until a few weeks ago. British engineers were not generally of the opinion that the Continent had anything to teach Great Britain in the way of refuse disposal, and this report apparently confirms that opinion.

Concerning Paris they report that "the value of the visit lay in the observation of avoidable defects." At Nancy they found conditions apparently similar to those at Paris except that a private company performing the work was relieving the taxpayers of a loss. In Cologne no definite facts and figures were available but only statements and claims. At Amsterdam and Rotterdam they found the principal lesson to be the value of centralizing disposal works. However, the Amsterdam plant was found to have been costly in construction and excessively so in operation. Perhaps the most successful plant was that at Rotterdam, but the plant there was similar to that installed by the same firm in a large number of English towns, steam generated by the distructor being used in connection with the municipal electric plant. Figures given appear to show that Amsterdam obtained an evaporation of one pound of water per pound of refuse and Rotterdam about half this amount. However, evaporative efficiencies up to 1½ pounds and 1¾ pounds have been common in England. The plant at Brussels was so poorly thought of that it was little more than mentioned.

In general, while the Glascow committee does not say so, it appears to be the opinion of many who have read the report, including the editor of "Municipal Engineering and the Sanitary Record," that it found nothing in Continental practice which was superior and little that was equal to the common practice in Great Britain.

One Hundred Per Cent. Water Bill Collection

Reports from some cities indicate difficulty in collecting water rents and some have felt that

a change from advance payments of flat rates to post-payments of meter rates would result in still greater losses to the Water Department. On the other hand, a number of water departments report that the amount of water rates unpaid is negligible. We imagine that it is largely a question of the energy of the collector and whether the consumers have or have not been allowed to fall into the habit of deferring payments.

The above is suggested by a statement in the report of Albert L. Sawyer, Water Registrar, of Haverhill, Mass., for the year 1921, in which he states "for the fifth time I am able to report that every water bill sent out during the year has been settled." Of the 8,558 services, 4,777 are metered, so that apparently metering does not interfere with collecting bills in this city. During the year the water was shut off from only one service for non-payment, and from the statement above quoted we conclude that this action was effective.

Federal Survey of Sewage Treatment Plants*

Results obtained in service by fifteen plants, representing all types in common use except chemical precipitation and disinfection. Received reasonably careful and intelligent operation and gave satisfactory results.

During the summer of 1920 the U. S. Public Health Service undertook a survey of fifteen sewage treatment plants located in twelve cities in different parts of the country which were considered to exemplify different typical processes and conditions. The objects of this survey were: 1—to obtain a bird's eye view of the field of sewage treatment; 2—to secure basic data by which the efficiency of service could be judged; 3—to suggest some standard test which might, without undue labor, be adopted at all plants so that results at different plants would be comparable.

The plants selected for the survey were, therefore, those which were felt to be representative, receiving reasonable, careful and intelligent operation. The devices and processes employed at these plants included primary plain sedimentation, septic, hydrolytic and Imhoff tanks; fine screens; trickling, contact and intermittent filters; secondary sedimentation; and activated sludge. It was originally planned to study chemical precipitation and Dortmund tanks, but they were for various reasons omitted from the schedule. At no plant visited was routine disinfection practised.

The basic data were collected by an engineer and a chemist. The engineer learned the details of design and construction of the plant, the population and industrial plants contributing to the sewers, and other factors bearing upon the operation of the plant together with the operating details; in some instances making special investigations of the use of sludge as a fertilizer or other subjects. The chemist spent from ten days to over two weeks at each plant analyzing an average of 12 series of 24-hour composite samples, taken hourly before and after each phase of the treatment. The samples were stored on ice during the period of collection and determinations were made by the same chemist (except at four plants), thus assuring identical methods and eliminating the personal equation in the comparison of results from any two plants. No nitrogen determinations other than nitrates were made at any except the activated sludge plants, where the ammoniacal nitrogen determination is of value in judging the efficiency of the aeration.

The plants surveyed were as follows: Imhoff tanks and trickling filters without secondary sedimentation at Atlanta, Georgia and Columbus, Ohio; plain sedimentation and Imhoff tanks, with contact beds and final intermittent filters of fine cinder or sand at Alliance, Ohio; Imhoff tanks and contact beds at Canton, Ohio; hydrolytic tanks, fine screens, trickling filters, secondary sedimentation and sludge digestion tanks at Baltimore, Maryland; Imhoff tanks, trickling filters and secondary sedimentation at Rochester, New York, Fitchburg, Massachusetts and Lexington, Ky.; septic tanks, trickling filters and secondary sedimentation at Reading, Pennsylvania; Riensch-Wurl screens, followed by Imhoff tanks and disposal by dilution without oxidation at Rochester, New York; activated sludge plants at Houston, San Marcos and Sherman, Texas. At Alliance and Canton, Ohio, were glass-covered sludge drying beds.

The average amount of sewage treated was about 94 gallons per capita, nine cities having smaller flows and six larger, six of the total being within 10 per cent. of the average, five others within 25 per cent. and the remaining four differing from the average by 36 per cent. to 38 per cent. The number of people served per sewer connection averaged 5.4 per cent.

* Abstracted from an article in Public Health Reports for June 23, 1922, by H. H. Wagenhals, Associate Sanitary Engineer of the U. S. Public Health Service.

The character of the sewage at the plants varied widely. Suspended matter ranged from 101 to 297 parts per million, averaging 174. Sewages with less than 100 parts per million are seldom encountered nor are there many municipal sewages carrying more than 297 parts except at plants where an unusual amount of industrial waste reaches the sewers.

Suspended matter was determined both in Imhoff glasses and by the Gooch crucible. The former gave settleable solids ranging from 1.9 to 4.9 c. c., which did not correspond very closely with the suspended matter as determined by the crucible. The Imhoff glasses gave readings of 4.8 c. c. with sewage containing 261 parts per million of suspended matter, while only 2.7 c. c. with sewage containing 297 parts and 2.0 c. c. with sewage containing 101 parts and others containing as high as 226 parts. The Gooch crucible method was considered much more reliable than the Imhoff glass.

The oxygen consumed values by the 30 minutes in boiling water method, ranged from 24 to 69 parts per million, averaging 44.

The five-day biochemical oxygen demand averaged 114 parts per million, with a range between 67 and 190.

IMHOFF TANKS

The Imhoff tanks removed on the average 59% of the suspended matter, and below 60 at only two plants; the figures at these plants, 37% and 40%, pulling down the average considerably.

The biochemical oxygen demand was reduced 42.5% and the permanganate oxygen consumed 36%. It is interesting to note that the reduction of the five-day oxygen demand was greater than that of the oxygen consumed. Studies by the U. S. Public Health Service at Cincinnati have indicated that removal of solids affects oxygen consumed to a much greater degree than it does oxygen demand.

Considering the amount of suspended matter in the effluent, which is more important than percentage removal, the Imhoff tank effluents at half the plants contained between 60 and 70 parts per million, while the highest of the fifteen plants was 119 and the lowest 40. Detention periods for normal flows averaged about 4 hours calculated on total displacement basis, and the velocity 0.6 foot per minute on the same basis.

With but one or two exceptions, most of the tanks foamed at one time or another, but this was more of an occasional nuisance than a serious difficulty and relief could be obtained by withdrawing the sludge, which method was accepted by all the plant operators as the only one giving permanent relief.

The capacity of the digesting chambers below the slot averaged for 10 of the 12 installations 1.1 cubic feet per capita served, the other two having capacities of 2¼ to 2½ cubic feet.

TRICKLING FILTERS

At six plants the trickling filters were preceded by Imhoff tanks, at one by hydrolytic tanks with a few Imhoff tanks, and at one by a septic tank. The depth of filters ranged from 5 feet to 10 feet but was between 5 and 6 feet in six of the eight plants. The rate of filtration of four plants was below 2,000,000 gallons per day and the other four above. The physical appearance of the effluent was good except from one plant, where there was considerable pooling. Some of these filters had been in continuous operation 10 to 12 years with very little expense other than occasionally going over the surface with a pick or harrow or flushing with a hose.

Although the raw sewages had a wide range of concentration, the effluents of the trickling filters were all so similar in composition that they might have come from the same filter on different days. As the filter is an oxidizing device, its efficiency must be judged not by the amount of suspended matter but by determinations involving the presence of oxygen. Those made were oxygen consumed, oxygen demand and nitrogen as nitrates. The last is considered of little value unless the amount of nitrogen in other forms present in the influent is known. Omitting the clogged filter, the oxygen consumed values fell within the range of 7 and 19, and the five-day oxygen demand between 4 and 20. The one clogged filter had an oxygen consumed value more than twice the average of the others and an oxygen demand value about 2½ times as great as the maximum for the others. The reduction of the methyl orange alkalinity was at no plant under 30% and at one plant was 92%, reducing from 99 to 8 parts per million. This same reduction in alkalinity was found in all properly operated oxidizing devices, such as the contact beds and aeration plants of the activated sludge process.

CONTACT BEDS

While the results of the contact beds at Alliance and Canton were not equal to the average of the trickling filters, they were entirely satisfactory for ultimate disposal with the dilution factors available. The oxygen consumed values were 11 and 18 respectively and the oxygen demand values 20 and 37. At neither place are these filters operated during the winter months.

FINE SCREENS

"The analytical methods used in the survey failed to show any accomplishment by the screens at Rochester during the period of the survey. Suspended and settleable solids and oxygen consumed were slightly higher in the effluent than the influent and the oxygen demand was slightly lower, but in none of the determinations was the difference of any significance. Computing from the screenings collected back to equivalent solids, the removal amounted to less than 1% or 2%." A rotating drum screen in Baltimore removed solids likely to clog the sprinkling filter nozzles and their efficiency is best represented by a reduction of about 87% in nozzles cleaned after the installation of the screens.

ACTIVATED SLUDGE

The activated sludge plants studied were two at Houston, one at San Marcos and one at Sherman, all in Texas. The two latter are quite

small, the San Marcos plant treating less than 200,000 gallons a day. The latter plant was visited every day by a general utility man who oiled the machinery and made a brief general inspection. The influent was a weak domestic sewage which had been previously passed through a septic tank. After this double treatment the effluent contained about three parts per million of suspended matter, and oxygen consumed value was about 8 and the oxygen demand about 16, with ample contained oxygen in the form of dissolved oxygen and nitrates to more than satisfy the demand. The annual cost of operation was about $1,400, or $20 per million gallons or $.56 per capita served, the contributing population being about 2,500.

Discussing the practicability of activated sludge plants for smaller communities, Mr. Wagenhals believes that too much emphasis has been placed on the so-called automatic operation of other types of sewage treatment devices and that none of them will work satisfactorily without attention, and he suggests that there is a distinct inherent advantage in a process that necessitates some attention. Motors and air compressors cannot run day after day without at least being oiled and to insure a daily visit to the plant is an important advantage. He even suggests that the activated sludge process may find its greatest field of usefulness in small installations rather than large ones, the sludge problem being greatly reduced in small installations where the amount is not sufficient to make possible the recovery of commercial value.

The plant at Sherman treated sewage that was extremely concentrated and fresh, receiving large amount of night soil, and the effluent was poor. The installation of a preliminary settling tank might greatly facilitate operation of the aeration plant. The two Houston plants produced excellent effluents and the problem there was the ultimate disposal of the sludge. (Recent tests with sulphur dioxide seem to promise fairly satisfactory solution of this problem.)

UTILIZATION OF SLUDGE

At Alliance, Canton and Rochester the sludge is all used by local farmers, charge being made at Rochester. The benefit of sludge to grasses, wheats, oats and other crops is very evident at Canton. Unfortunately, none of the results obtained by the farmers can be given in quantitative figures. One farmer stated that by actual weight he obtained, with two cuttings, 34 tons of grass from 9 acres treated with sludge, while 40 acres in the same field not so treated totaled only 42 tons. It is admitted that such reports are different from experiences of other places. The author believes that at most sewage treatment plants a local demand for sludge can be created on an actual value basis which will even produce a revenue that will help pay for handling the sludge after its removal from the tanks.

CAUSES OF FAILURE

Sewage treatment plants may fail in operation either because (1) the processes may not in themselves be capable of producing a good effluent; (2) the design of the individual plant may be at fault; (3) it may be poorly operated, or as is often the case, receive no operation at all.

Although opinions have been expressed, even among those familiarly connected with sewage treatment, that the whole system and theory of sewage treatment practices have fallen down, this survey made by the Public Health Service indicates that "there does not appear to be much ground for pessimistic criticisms of general theories of sewage treatment on the basis of their failure to effect adequate purification."

The second cause of failure can be largely eliminated when public and especially city officials thoroughly understand that the designing of treatment plants is a specialized branch of professional engineering and that such plants are not a part of the city's plumbing system.

LABORATORY DETERMINATIONS

The primary function of preparing sewage for disposal by dilution without creating objectionable conditions either at the plant or in the receiving body of water was being accomplished by the plants visited with one or two exceptions. At only two out of the 14 operating oxidizing devices was the color reduced in the methylene blue putrescribility tests of the effluent incubated at room temperature, and at one of these two the samples stood up for from 3 to 8 days. Only four of them had biochemical oxygen demand in excess of 20 and all contained oxygen to partially satisfy this demand. Moreover, the treatment process removed practically all of the settleable solids.

These two results, the reduction of solids and the partial oxidation of the organic matter not removed by such reduction, are the two functions commonly required of such plants. In isolated cases the reduction of bacteria may be desirable for the protection of near water supplies or bathing beaches. This being the case, Mr. Wagenhals believes that two determinations, one for the removal of suspended matter and the other for the reduction in oxygen demand, are the backbone of the laboratory routine of the average plant. With special methods of treatment others may be needed, as for instance the ammoniacal nitrogen determination for controlling the aeration processes at activated sludge plants. Of course, when bacterial removal is a function of the plant, total bacteria counts are essential for the proper operation of the disinfecting process.

Refuse Incinerator Lettings

Bids were received by several cities for refuse incinerators during the first two weeks of August, and figures for four of these were, we are informed, as follows:

Daytona, Florida:

Jones Odorless Crematory Co., 15 ton plant.....	$12.000
Nye Odorless Company, 16 ton plant.....	11,500
Vulcan Incinerator Company, 15 ton 24 hours...	11,365

Sanford, Florida:

Jones 16 ton plant	$13,250
Vulcan Incinerator Company, 15 ton plant	14,250
Nye Plant, 12 ton	11,500
Contract awarded to Jones Odorless Co., at	13,250

West Allis, Wisconsin:

Decarie Incinerator Co.	$32,700
Markmann Incinerator Co.	39,500
Badger Reduction Co.	23,875
Nye Odorless Co.	20,000
Superior Garbage Company	22,125
Dollarhide and Elliot	20,190
Jones Odorless Co.	18,000
Vulcan Incinerator Co.	17,750

All bids under advisement, until the Council secures a site.

Quincy, Illinois:

Jones Odorless Company	$18,000
J. W. Stokes	17,000
Decarie Incinerator Co.	24,900

All bids pending under advisement until a selection of a site.

A New Type of Road Drag

Iowa State Highway Commission uses old War Department materials to make a heavy drag that does some of the work of a blade grader.

A new type of road drag has been devised by the Road Maintenance Department of the Iowa State Highway Commission, the plans having been prepared by O. M. Briley of the Maintenance Department and the first sample having been built by mechanics at the warehouses and machine shop of the Highway Commission. The drag was given its first tryout on the roads of the Iowa State College at Ames and in May started on a tour of the state. Boone county and possibly others have constructed similar drags from unused material lying in its storage piles and warehouses.

The Commission believes that every county store yard contains wheels and axles, beams and miscellaneous material that is rusting away but which, with a little ingenuity and labor, can be put to use by the Road Department, and it is with the idea of suggesting probable ways of utilizing this unused material that the Commission had this machine put together.

The materials used were a pair of old War Department gun caisson wheels with an axle, some eye beams, two or three lengths of cable, two lifting jacks and a small cable drum, almost all former War Department materials. With this combination of material a wheeled road drag was constructed that is heavy enough to do on soft dirt roads some of the work usually done by a blade grader. It is designed to be drawn behind a heavy truck.

The drag consists of two 16-foot channel irons extending longitudinally on the outside of the frame, and two 22-foot channels placed parallel to and equally spaced between these. Three angle irons, each approximately 16 feet long, are fastened under these four longitudinal channels, each with one angle vertical and the horizontal angle on top and fastened to the bottom flanges of the channel irons. Two of the angle irons are set at similar angles to the longitudinal channels, one at each end of the frame, while the third is set diagonally between these and sloping in the opposite direction from the longitudinal axis of the drag. These angle irons are so attached in the frame work thus built up that the two outside ones work the dirt towards the center of the road when the drag is in use, and the middle one works it towards the outer edge. The result of this arrangement is that the front angle iron throws the dirt towards the center of the road, the middle blade, which extends a short distance beyond the inner end of the front drag, picks up the material and works it back again towards the outer edge; while the third or rear blade, which extends further towards the gutter than the center blade, once more throws the dirt back towards the center. This criss-cross motion to which the material is subjected aids materially in filling small holes and ruts and crushing clods. A saw-tooth bar is hinged loosely on the end of the central blade that is nearest the side of the road and acts as a clod or stone remover, all clods that are not crushed and all small stones that are too large to be pressed into the surface being thrown to the extreme outer edge of the roadway and entirely clear of the travelled surface. This bar can be raised entirely out of contact with the surface if desired. It works loosely on a bolt and is provided with a spring, so that if it catches on any obstruction it will yield until dragged by and then spring back again into place.

This frame is dragged behind the truck. In addition to the frame work just described, a pair of wheels and axle are attached by chains to the side channels of the frame so that the wheels rest on the road between the middle and rear angle irons and inside the outside channels. The driver rides on a seat fastened on this axle. In addition there is on the axle a small drum carrying a cable which is attached to the frame, by which the frame can be lifted from contact with the road when it is desired to travel rapidly from point to point without operating the drag.

It is claimed that while it requires a skilled man and constant attention to run an ordinary road drag effectively, almost any one can operate this one successfully, for it automatically takes care of all the variations in the road surface, the long base and criss-cross motion tend to carry the dirt forward from high spots and to fill in low places, and there is no tendency at all to gouge in where the soil is soft or where there is a low spot. New material deposited on the road is picked up easily and slid along for a considerable distance, giving it an even distribution.

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Water Meters and Economy

There are two major arguments in favor of metering water services: one, that the only method of charging for water that is equitable and fair to all consumers is to base the charge on the quantity consumed; the other, that useless waste of water means additional expense to the taxpayers or the consumers, that it can be prevented only by making the wasters pay, and that the only way to detect and prove waste is to meter the water that enters each service.

From the point of view of economy alone meters may in some cases cause a loss rather than a saving—the cost of installing, maintaining and reading the meter may exceed the value of the water saved.

However, it is not only the cost of the water now being delivered that must be considered, but also that of a supplementary supply; and such supply may cost two or three times as much per million gallons as the present one. Elsewhere in this issue is presented the explanation by Commissioner Wall of St. Louis why metering, if it had been begun soon enough, would have saved that city several million dollars. but has been deferred until now the opportunity to effect an economy by metering has passed.

State Funds for City Streets

It is quite common for States to contribute towards the cost of highways voted by counties or by townships or other small political units, but State funds are seldom if ever given to municipalities for street work except where the streets form parts of county or State highways and are built, maintained and controlled as such. Mayor Moore of Philadelphia under whose administration nearly 100 miles of streets have been paved at a cost of nearly $2,000,000, is reported to have said in a recent interview: "We could go much further with street improvements if we could obtain some reasonable return from the State for the money paid on automobile licenses. The paving we do is torn up by heavy trucks and automobiles coming from all parts of the State, some of the trucks running a standardized business in competition with railroads and other transportation lines which are compelled to pay taxes in one form or another."

This would appear to be simply a variation of the old problem of assessing pavement costs. Assessing these against the property facing upon the highway improved is the simplest plan but also the least equitable. The editor of PUBLIC WORKS has frequently expressed in the columns of this paper his opinion that paving the main thoroughfares of the city should not be charged against the abutting property, but that the assessment against such property should be limited to the cost of a pavement sufficient for the local needs only—ordinarily the type adopted by the city in question for its minor residence streets; the balance to be paid by the city at large, since the additional durability and resulting cost are necessitated by the general traffic which in no way benefits the abutting property. An exception to this might be made in the case where business property is benefited by the abundant traffic of the thoroughfare, but the difficulty of adjusting an allotment of this kind might be eliminated by considering that the tax paid by the owner on his business included this additional cost of paving.

If this principle is a correct one, and it appears to us that the only logical one is along such lines, it would also apply to the use of city pavements by State traffic using a city street merely as a thoroughfare for going from one part of the State to another. This complication, as well as the congestion of traffic resulting from passing State highway traffic through city streets, is avoided in some States by the general practice of running State highways by, rather than through, the cities along its route. Where this is not done, there would certainly seem to be much justice in the suggestion that the State should compensate the cities for a part at least of the wear of the city pavement caused by through State traffic.

An interesting news item bearing upon this point comes from New Orleans, where the State of Louisiana has begun the maintenance of a street entirely within the city limits. However, the engineer of the State highway commission said that it was the policy of the commission only to build roads up to the municipal lines and not within the cities. "The department is undertaking the maintenance of the Chef Menteur Road (the one referred to above) because it is really a country road and the sole outlet in that direction, although technically it is within the city limits." In Georgia it has been decided that counties may pave roads or streets leading to the county court house, right up to the court house steps, apparently.

Municipal Inspection of Sewer Connections

A report of the city engineer of a southern city of some size for the latest fiscal year reveals a condition which is a serious one and should have received attention long before this; and yet it is one which we fear can be found existing in a number of other cities.

He reports: "Many parts of our existing sanitary sewerage system are now overloaded. The unlawful connection of downspouts from roofs, to the sanitary sewer has largely increased this overloading and must be stopped. Overflows have been cut into storm water sewers from the sanitary sewer to relieve them during the times they are overtaxed, but this is but a temporary relief and should not be allowed to continue, for the constant use of storm sewers for this purpose will be unsanitary and dangerous to the public health."

The sanitary sewers in this town are practically operating as combined sewers, although calculated for dry weather flow only, and the fact that they are gorged is not necessarily any reflection upon the designer or the system, but rather upon the officials who have been in charge of operating the system or others who have permitted a connection of rain water leaders with the sewers.

The discharge of the overflow from these, when acting as combined sewers. into storm water sewers is, we believe, something of a novelty, although overflows to streams from combined sewers designed as such are quite common. Whether this serves as a sufficient relief for the congesting of the sanitary sewers may be questioned, since the same report states that a number of the storm sewers have been ruptured recently from run-off from the streets, one of them having blown up the pavement almost yearly for several years past.

Both of these features of the sewer system seem to indicate a failure on the part of the officials to take any forethought of the results of the heavy rains that occur several times every year. Another indication of the same lack of appreciation of the volume of run-off from a street or even a roof is found in the same city, where a creek which drains a large part of the city is being continually made narrower and shallower by the dumping of refuse along its banks. This naturally and inevitably leads to a flooding of lands and buildings along the creek. The result of these failures to provide for the removal of rain water must be a cost to the citizens directly, or indirectly through the city taxes, of many thousands of dollars a year.

This city is referred to merely because the report quoted has recently reached our desk. We have, however, information concerning many other cities where conditions are similar if not quite so bad. An engineer of a Kansas city reports that the connection of roof drains to sanitary sewers is prohibited, but it is known that a great many such connections exist because the flow in the sewer increases nearly 50% after a rainstorm, although practically all the sewers are laid above ground water. An Oklahoma city engineer reports that in his city a vast number of houses have surreptitiously connected the rain water leaders to sanitary sewers and several of these become overcharged with storm water. In this city also connections are made with the storm sewers by means of pipes connected to the manholes of the sanitary sewers near their tops. A large city in Tennessee experiences serious difficulty from the same cause, finding it very difficult to prevent the surreptitious connection of roof water leaders with sanitary sewers.

It would seem to be self-evident that there is only one method of preventing this misuse of sanitary sewers and that is to maintain strict supervision over plumbing of all buildings, requiring that an inspector of the sewer department, or of such other department as may have charge of building construction, inspect each connection with the sewer in buildings in which plumbing has just been installed before this connection is covered up, and imposing a heavy penalty upon any plumber or householder who is found to construct and cover up a sewer connection without its having been inspected by the proper municipal department. Once the connection with the sewer has been made, it is almost impossible to determine not only whether it has been made properly, but even whether it has been made with the right sewer where there are both storm and separate sewers passing in front of the property.

Water Main in River Bed Eroded

Several of the mains of Denver's water works cross the Platte river, and at least one of these, a 20-inch cast iron line, was laid in the sandy deposit in the bottom of the river. A few weeks ago floods in the river washed away the sand covering the pipe line so as to expose it, following which floating debris broke the line so that it had to be replaced. When it was taken up, it was found that the attrition of the sand in the river bed had decreased the thickness of the pipe from 0.8 of an inch to 0.25 inch, showing a loss from this cause of more than 1/2-inch in the sixteen years that the pipe had been in place.

In replacing the line, the new pipe was placed some distance below the bottom of the river and was covered with 36 inches of concrete.

Another cast-iron main, 36 inches in diameter, had been supported upon cement piers in the bed of the river, and after being damaged by the flood was relaid in a trench carried down into bed rock in bed of the river and covered with 24 inches of concrete.

Annual Costs of Florida Highways

Different kinds of roads compared on basis of annual maintenance and depreciation under Florida traffic conditions

The county engineer of Duval County, Fla., George B. Hills, has recently submitted to the county commissioners a report dealing with the suitability of various types of pavement for use in that county. He considers eight types of pavement as follows: Plain shell; shell treated with bindex, dustex or similar sulphide liquors; Augusta gravel similarly treated; Ocala limestone with a bituminous surface treatment; bituminous penetration on a limestone base; sheet asphalt with binder course on limestone base; vitrified brick with bituminous joints on sand base; vitrified brick with bituminous joints on limestone base.

He has estimated the cost of construction and maintenance of these various kinds of roads under traffic conditions as found in Duval county, taking as the unit one mile of road 16 feet wide.

The shell roads are made of oyster or periwinkle shell, which costs approximately $3.50 per cubic yard spread in place. This is satisfactory for light horse-drawn traffic but not for rubber-tired automobiles. They are dusty when dry and wash badly when it rains, and are expensive to maintain. They will last two years under a traffic not exceeding 300 vehicles per day. If sulphite liquid is used as a binder at the rate of 1 gallon per square yard initial and 1/8 gallon at four-month intervals, the life may be extended to five years.

Augusta gravel is a mixture of gravel, sand and clay with some kaolin. The gravel costs $1.52 per ton f. o. b. Jacksonville. It is believed that under traffic not exceeding 450 or 500 vehicles per day, such a road would last 10 years.

Ocala limestone is mixed in several quarries in Florida and is excellent as foundation material owing to its cementing qualities and elasticity. It is recommended that it be used for roads with a thickness of 6 inches, surface treating with ¼ gallon of Tarvia B and 1/3 gallon of Tarvia A, covered with slag or granite chips; to be used as a foundation when a more durable surface is required. The stone costs $2.00 per cubic yard f. o. b. Duval County.

Two and one-half inch bituminous penetration is assumed to have a life, with proper maintenance, of 25 years under a traffic up to 1,500 vehicles per day. Slag or granite could be used as aggregate.

Sheet asphalt would handle any traffic to which the roads may reasonably be subjected and with proper maintenance would last for 30 years.

Vertical fibre brick with bituminous joints on a sand base is estimated to withstand a traffic of 650 or 700 vehicles per day for 25 years; or, if placed on a 3" limestone base, would carry any traffic reasonably to be expected for 30 years.

On this basis as to first costs, and life and maintenance costs as indicated, annual costs per mile were calculated which are shown in the following table:

Type of Road	Capacity in Vehicles Per Day	Initial Cost Per Mile	Annual Maintenance Per Mile	Estimated Life Years	Average Annual Cost Per Mile	Residual Value
Plain shell	300	$ 3,912.50	$400.00	2	$2,356.25	None
Shell and Bindex.....	300–350	5,696.00	788.59	5	1,943.24	None
Augusta Gravel and Bindex..	450–500	9,293.90	788.59	10	1,733.43	Small
Limestone, surface treated..	750–800	8,610.75	786.96	20	1,181.50	$6,000.00
Bituminous penetration.....	1,500	20,028.00	393.48	25	1,194.60	7,500.00
Sheet asphalt.....	3,000	32,844.50	350.00	30	1,111.48	9,000.00
Brick on sand, bit. joints.....	656–700	29,722.30	500.00	25	1,688.89	2,500.00
Brick on limestone, bit. joints	3,000	32,854.30	250.00	30	1,345.14	6,000.00

Mr. Hills does not recommend construction of any more shell roads, but that the county adopt as standard, sheet asphalt or vitrified brick on limestone foundation; or, until sufficient funds become available, that main highways be given such permanent pavements to the extent of the funds available, while secondary roads be given a bituminous penetration surface on 6-inch foundation, and those of still less importance be covered with surface-treated limestone constructed by county forces.

Color of Fire Hydrants

Probably the majority of fire hydrants in the United States have been painted dark green or some other dark color with a view to rendering them as inconspicuous as possible, although some cities have used white and others silver. Objections to these last are that when snow is on the ground it is almost impossible to see the hydrants at night and the firemen may thus be delayed several valuable minutes in connecting up their hose.

Recently the Water Bureau of Philadelphia endeavored to select a paint that would make hydrants as conspicuous as possible under all conditions, so that they could be found quickly by the firemen and also obviate the excuse offered by automobilists that they did not notice the hydrant when they are found violating the regulations by parking too near it. The Bureau consulted with firemen, teamsters, automobilists and traffic officials. Fire department officials considered yellow the best color because it can be seen easily at night and in foggy or rainy weather. Also yellow paint is considered to be a durable color, and it was adopted by the Bureau after having been tried on several hydrants located in the center of the city.

Emsworth Lock and Dam Construction

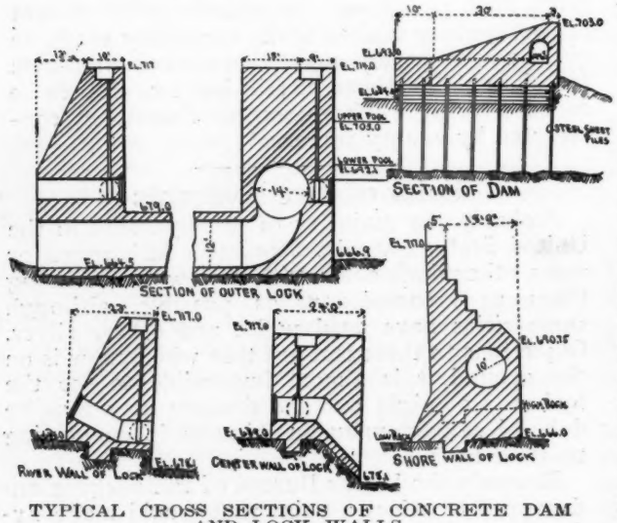
Successive sectional cofferdams aggregating 3,838 lineal feet used for construction of lock and 1,725 lineal feet of low dam. One hundred and eight thousand yards of concrete mixed and placed by special land and floating plants

The Federal improvement of the Ohio river at Emsworth, Pennsylvania, includes the construction of a 110 x 600-foot and 56 x 360-foot concrete lock, and a fixed dam across the main channel of the river to Neville Island and from the opposite shore of the Island across the back channel of the Ohio river with an aggregate length of 1,725 feet. This improvement was made by the aid of 3,838 feet of cofferdam and involved about 109,700 cubic yards of common excavation, 90,760 cubic yards of rock excavation, about 108,000 cubic yards of concrete, 24,500 cubic yards of rip-rap, 60,000 lineal feet of wooden piles and 2,740,000 pounds of steel sheet piles. The contract was awarded to The Dravo Contracting Company, Pittsburgh, which commenced active operations August 1919, and had 98 per cent. completed May 1st, 1922.

GENERAL DESCRIPTION

The work is of simple mass concrete construction with moderate dimensions, the lock walls having a maximum width and height of 24 feet and 51 feet respectively, and the dam a width of 43 feet and a height of 15 feet to the bottom of the concrete. The foundations of the concrete walls are carried down to solid rock at distances below the crest of the dam varying from 18 feet at the up-stream end of the lock to 33 feet for the river dam, and 23 feet for the shore wall. The low water level, elevation 688, is 15 feet below the crest of the dam, and 22 feet above the lowest foundation.

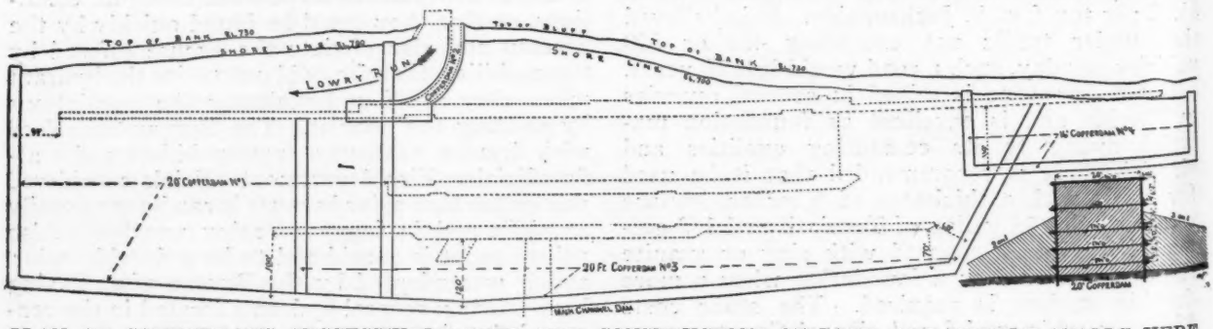
The river bed at the site of the lock and dam consisted of from 5 to 24 feet of earth and gravel overlying the rock bottom and covered with 10 to 22 feet of water with a velocity ranging from nothing, when dams are up, to 8 miles per hour in time of freshet flow. It was, therefore, necessary to execute most of the work in cofferdams, of which there were used 3,838 feet of the box type, 16 and 20 feet wide and about 1,500 lineal feet of single line sheet piles. The box cofferdams of the type commonly used in that vicinity consisted of parallel vertical rows of 2-inch wooden sheet piles from 16 to 24 feet long, nailed to wales and held together with rods—the typical Ohio river box coffer.



TYPICAL CROSS SECTIONS OF CONCRETE DAM AND LOCK WALLS.

COFFERDAMS

The 20-foot cofferdams were braced with five tiers of wales and tie-rods and the 16-foot cofferdams were braced with three tiers corresponding to the three upper tiers of the 20-foot cofferdam. The space between the double rows of sheet piles was filled with earth, sand and gravel dredged from the interior of the cofferdam and the same material was used to make an embankment carried up to the surface of the water on both sides of the cofferdam. The cofferdams were built to an elevation of about 16 feet above low water (elevation 688.0) and the width was made equal to the height. The length of the structure permitted to be built in a single cofferdam was limited by the Government to 1,941 feet of land lock wall and land guide wall, 350 feet of main channel dam and 750 feet of back channel dam, and



PLAN OF COFFERDAMS SUCCESSIVELY USED FOR CONSTRUCTION OF LOCK AND GIRDLE WALLS HERE SHOWN IN DOTTED LINES. ADJACENT END OF MAIN CHANNEL DAM INDICATED NEAR CENTER OF LOCK

special permission was required for construction of more than 350 lineal feet of dam in a single dam. The cofferdams were paid for on a basis of 65 per cent when the cofferdams were completed and dug out and the remaining 35 per cent. after the removal of the cofferdams.

The first cofferdam built was U-shape in plan, known as cofferdam No. 1 and was about 1,500 feet long, with river arm about 640 feet long and 20 feet wide in section. In it there was built about 550 feet of the lower land guide wall approximately parallel to and about 100 feet average distance from the shore line and 185 feet of lower river guide wall. The material inside this cofferdam, as well as the other cofferdam, was excavated by steam shovels and draglines, used in connection with drilling and blasting after the cofferdam was unwatered.

PUMPING AND EXCAVATING

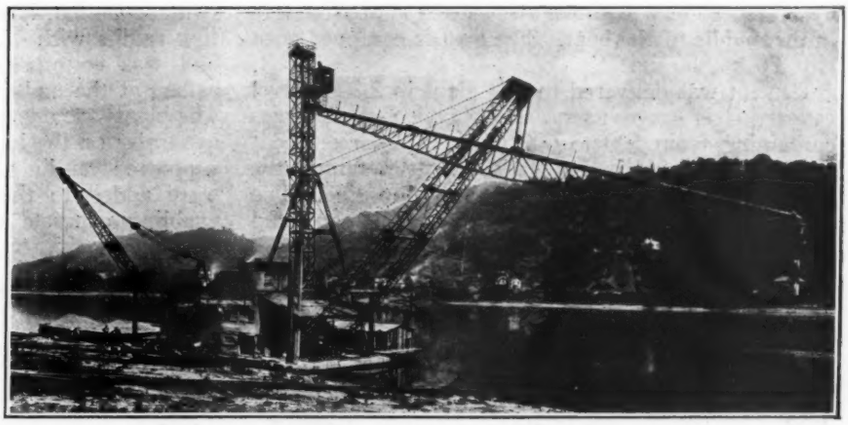
There was installed on the work, a floating pumping plant of centrifugal pumps that were used as required for unwatering the different cofferdams and keeping them drained. Cofferdams No. 1 and No. 3 were unwatered by four electrically driven centrifugal pumps, 14-inch suction and 12-inch discharge. Cofferdams No. 2 and No. 4 were unwatered by one 6-inch and one 8-inch centrifugal steam driven pumps.

The rock excavation was made with eight Ingersoll Rand air drills and the spoil was handled by buckets operated by Bucyrus dragline and three Dravo land whirlers of capacity of 18,000 pounds at 70-foot radius, operated at a hoisting speed of 150 feet per minute on a single line and a swinging speed of 360 degrees in 30 seconds, enabling them to make a complete round trip in a minimum time of about one and one-half minutes.

The material for the most part was loaded in steel skip boxes of from 2 to 5 yards capacity. These skip boxes were hauled on flat cars by steam dinkey to end of cofferdam, where the skips were loaded on barges; the barges towed across the river and their contents dumped in spoil piles. A large number of skip boxes (50 to 75) were required for this purpose, but the saving of rehandling the rock by hand was well worth the outlay for skip boxes. The skip boxes were handled throughout by the whirlers and derrick boats and barges.

After the completion of the guide wall in cofferdam No. 1, the sheet steel-pile cofferdam No. 2 was built enclosing the upper end of the finished portion of guide wall and extending to the river bank, diverting the flow of Lowry run behind the guide wall and discharging it into the river below the guide wall instead of above the guide wall as previously. This cofferdam had about 340 lineal feet of timber walls composed of 12-inch Lackawanna steel sheet piles with arch webs ½-inch thick. The piles, 36 feet long, were driven at an average rate of 70 piles per eight-hour day by one Vulcan No. 2 steam hammer. The cofferdam made with them was about 25 feet wide and 195 feet long, and was kept dry by the use of a single 6-inch centrifugal pump working full time.

Box cofferdam No. 4 16 feet wide and about 700 feet long, was built to permit the construction of 330 feet of the upper guide wall simultaneous with that of the lower guide wall, thus saving some time over what would have been required if this part of the wall had been constructed in main cofferdam No. 3. Main cofferdam No. 3 was 20 feet high and overlapped cofferdam No. 1 by about 150 feet. It was about 1,750 feet in length and was kept dry



FLOATING CONCRETE PLANT WITH 100-FOOT STEEL TOWER AND 150-FOOT DISTRIBUTING BOOM. CAPACITY 600 YARDS IN 10 HOURS WITH 6-MAN CREW.

GENERAL VIEW OF LOCKS, SHORE WALL AND PART OF DAM AND FLOATING EQUIPMENT

by one 12-inch centrifugal pump at about full capacity.

FLOATING CONCRETE PLANT

About 50,000 yards of concrete required for the lock and guide walls was mixed and placed by a movable plant installed on a 40 x 110-foot steel hull 7 feet deep that was moored in the river alongside the cofferdam. The same plant was also used for 28,000 yards of concrete in the dams and their abutments.

Part of the concrete for the lock was placed by a 1-yard mixer and 80-foot tower mounted on a wooden base with 14-foot gauge track. This plant was located between the walls of the large lock and moved to the full length.

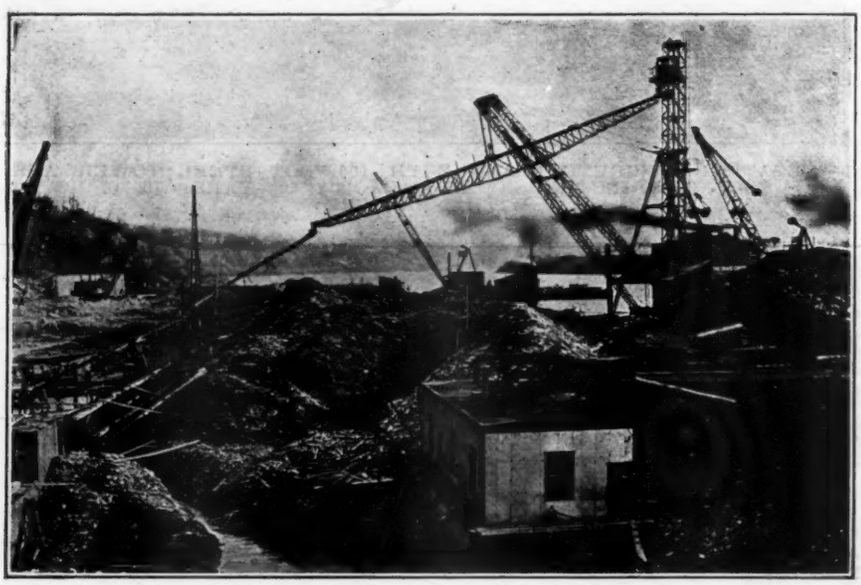
The main mixing plant was a permanent unit made up of a steel hull 40 feet by 110 feet by 7 feet. 6 inches deep. On one end of this hull is a Dravo Steel Whirler with 10 x 12-inch triple drum engine, swinger and a 90 foot boom, which handles a 2-½-yard clamshell and feeds the sand and gravel to the bins. Bins, 1-½ yard mixer and 100-foot tower are located on opposite end of hull and a permanent bridge supported by an A-frame delivers concrete a distance of 150 feet beyond the bow of the boat; an additional 60 ft. to 80 ft. of trussed concrete chute was used to carry the concrete from the end of the bridge to the walls. This plant has a capacity of about 75 yards per hour and was used on both the lock and the dam. The mixer, cement elevator, and tower hoist are all connected to and operated by a 14 x 16 inch Erie engine, located approximately in the middle of the boat. The boat is equipped with two 70-hp. boilers.

Cement was delivered to this plant in 2,200-barrel covered steel barges; sand and gravel in steel barges containing from 500 to 600 tons. The mixer boat is equipped with power capstans to facilitate the handling of these barges of material alongside. The entire outfit of mixer boat, two barges of sand and gravel and barge of cement have been held and concreting operations continued with mixer boat lying broadside of the river in a current of such magnitude that an artificial head of about two feet was created against the upstream side of the boat. This current was estimated at about 6 miles per hour or more.

The concrete mixer discharged to a bucket in the foot of the hoisting tower 100 feet high. The bucket was elevated in the tower and dumped its contents into a chute carried on a pair of steel trusses 150 feet long that were inclined one to three from the horizontal, pivoted at the upper end to the tower, and suspended near the center by a five part tackle and steel links and guyed to the hoisting tower 60 feet above the deck, where the latter was connected to the top of steel stiff-legs. There was provided at the lower end of the trusses, a movable radial chute through which the concrete was spouted to required position in the forms.

The barge was equipped with a 14 x 16-inch Erie single cylinder steam engine, a 50-horse power Lambert bucket hoisting engine with 26-inch drum, and 9-½ x 10-inch double cylinder three-drum Lambert hoist for the boom and bridge, two 4-½ x 5-inch double cylinder Ball engines for the capstans, and two 10 x 8 x 12-inch American Service pumps, one March 5-½ x 8 x 12-inch boiler steam pump, one 200-hp. Cochrane vertical open feed-water heater, and one 10-½-inch Westinghouse air compressor.

The whirler was equipped with a 10-½ x 12-inch double-cylinder three-drum Lambert hoisting engine, and a 6½- x 10-inch double-cylinder Lambert swinger engine, having a capacity of ten tons at 70 foot radius with 45,000 pound counterweight. The hull was counterweighted with 70,000 pounds of ballast at the end farthest from the hoisting tower. The plant was operated by a crew of six men. When in service on the lock, several sections of steel chute supported on light towers of movable false work were added to the end of the suspended bridge, enabling concrete to be delivered at a maximum distance of 225 feet from the hoisting tower. These auxiliary chutes, in sections 45 feet long, were trussed, and weighed about two tons each.



STEEL MIXER BOAT CONCRETING LOCK WALL. PUMP BOAT, DERRICK BOAT AND WHIRLER IN FOREGROUND, BACKGROUND AND AT LEFT, RESPECTIVELY.

About 45,000 yards of concrete in the land guide wall and part of the upper and middle lock walls of the lock were mixed by a movable land plant operated by four men, having a maximum output of 375 yards in one eight-hour day.

The principal materials involved in the work included Iron castings 243,710 pounds; steel 17,584 pounds; forgings 57,730 pounds; bolts 57,920 pounds; bronze 844 pounds; reinforcing 2,838 pounds; structural steel 163,173 pounds; common timbers 335,-210 feet B. M.

The work was concluded under the direction of Major J. Franklin Bell, United States Army.

Steel Water Mains in New Bedford

Large opening cut in 36-inch steel pipe twenty-two years old permits inspection of interior. About half the inside pitted.

The Water Board of New Bedford, Mass., about twenty-two years ago laid a 48-inch steel force main and recently had opportunity to determine the condition of this main. A new 48-inch cast iron main is being laid and connected with the old 48-inch steel main, which required making a 36-inch opening in the steel pipe.

"An examination of the piece which was cut out of the steel main," said Superintendent Coggeshall in his annual report, "indicates that the main is in as good condition as might be expected after 22 years of service. The outside of the pipe is in perfect condition but about half of the area of the inside is more or less pitted. Some of these pittings are small in area and quite deep (the deepest being about 1/8-inch or approximately 40% of the original thickness), while others are of large area and very little depth.

"Assuming that the whole of the steel main is in similar condition, we may expect about ten or fifteen years more service from this pipe. Before this time a new main should be laid from the 48-inch main at Beaver Dam to High Hill reservoir to be ready for use when the steel main gives out. A 'Y' branch and gate in the new main have been installed for this purpose, so that the work can be continued without interfering with the use of the present 48-inch cast iron main.

"Mr. Conrad's report of the condition of the steel main, as indicated by the piece which was removed, is herewith presented:

An examination of the interior of the 48-inch steel force main immediately adjacent to the gate near where the Middleboro road crosses the line, at what is known as Beaver Dam, disclosed that the interior is tuberculating considerably and that almost without exception wherever there is an accumulation of iron oxide there is a depression or pit in the wall of the pipe which varies in depth from 1/64 to 1/8 inch and there are some that would go beyond 1/8 of an inch in depth. In the pipe itself it would be unwise to disturb these tubercles, as unless the surface was thoroughly cleaned and a protective coating put on, the rate of growth of the pit would be accelerated.

At the place where the interior of the pipe was examined, a piece of pipe about 36 inches in diameter was cut out to provide for a cross connection with the 48-inch cast iron line, which is being constructed to connect with the 36-inch pipe at City Line and Acushnet Ave. A calibration of this piece of pipe would indicate that the thickness of metal runs fully as heavy as was called for, namely—5/16 of an inch. It was not attempted to count the number of pittings in this piece of plate, but there are at least 200 and probably 250 or more places from ¼ to 30 square inches in area scattered over the interior surface, which vary in depth from 1/16-inch to 1/8-inch, which means a reduction in the thickness of the plate at these points of from 20 to 40 per cent. It is probable that the major portion of this pitting occurred during earlier years of the pipe in service, and that their growth has slowed up somewhat, but it can readily be grasped that the years longer that the pipe line will continue to give the remarkable service that it has given during the past 22 years are probably numbered, and that probably within the next 12 to 15 years at longest it is likely to begin to give trouble and it may be necessary, because of possible high maintenance and repair expense, either to put in a continuation of the cast iron line from Beaver Dam to High Hill Reservoir, and use the new line when completed for the main pumping line, holding the steel as a reserve, or else put in the cast iron line to High Hill and immediately prepare to replace the present steel line with another of steel, iron, or whatever material at the time appears best suited for the purposes intended.

An examination of the exterior of the pipe would indicate little if any deterioration of the plate on the outside, which means that the soil conditions over the pipe line right of way have been most favorable, and that the necessity for frequent examination on the outside to detect trouble is not going to be so necessary as a frequent examination inside from now on.

Water-Tight Joints for Sewer Pipes

Tests at Carnegie Institute of Technology of bituminous compounds applied under different conditions and by different methods.

The College of Industries of Carnegie Institute of Technology at Pittsburgh has recently made public the result of tests made of the use of bituminous compounds as jointing materials for vitrified clay pipe. These experiments were made by Prof. S. E. Dibble, and are accompanied by chemical analyses of the materials made by Prof. R. B. Leighou. A final report on the test was made in March of this year by Prof. Dibble. From this report the following synopsis of the test has been prepared.

The purpose of the test was explained to be a determination whether or not cement joints and compound joints could be successfully made to stand a 5 and 10 pound gage pressure; also to establish a procedure for making joints to stand a 10 to 20 foot head. "Actual conditions, as nearly as possible, have been carried out throughout the entire test; only tools and methods used in a trench were used. No care was taken to prepare the bell or the end of the pipe in any way."

Tests were made on 4-inch, 6-inch, 8-inch and 10-inch pipes, some with the surfaces at the joint unglazed and some glazed throughout. Cement and sand were used mixed one to one and in one case neat cement was used. Three bituminous jointing compounds were used, the names of which were not given, but analyses of the three were furnished Although there is a material difference in the chemical analyses of the compounds, the report makes no distinction between them by specifying which one was used in any particular test.

A bulletin issued by the secretary of the institute

states that these tests have established "that a proper bituminous compound can be used efficiently in jointing a pipe; that joints made in the manner developed by Prof. Dibble will stand any pressure that the pipe itself is capable of standing, without showing any leaks; that a pipe line so jointed can be thrown out of alignment without causing a leakage at the joints; and that leaks due to poor workmanship can be repaired easily and quickly."

These tests also show quite clearly that if the oakum placed first in the joint is wet, or if the pipe is wet at the time the melted bituminous compound is poured into it, a tight joint cannot be made. As the probability is that use of joints of this kind will be confined largely to wet trenches where the necessity for tightness is greatest, it is apparent that this is a serious objection to the use of the material. The reason assigned for the impossibility of securing tight joints under the condition described is that the water present is turned to steam when bituminous material, heated to a temperature of more than 300 degrees comes in contact with it and this steam in escaping forms open passages in the bituminous material or between it and the pipe. While it is not impossible to prevent the oakum from being wet before or after it has been placed in the joint nor to have the bell and spigot dry at the time of pouring the compound, the effecting of this will add to the cost of the use of the material, and the difficulty of securing this condition with the class of labor ordinarily employed in sewer work lessens the probability of securing tighter joints with this than with the common cement joints.

Where the material was placed in a dry bell, with the bituminous material heated to about 450 degrees and the asbestos joint runner left on for 4 or 5 minutes after pouring, all joints remained tight under 15 pounds pressure, and in some cases 20 pounds left the joints still tight.

It was found that the material should be heated until it was as liquid as water, which apparently meant 450 to 500 degrees, and must be poured rapidly so that it would not have a chance to cool before the joint was entirely filled. In order to prevent the compound flowing into the pipe, a strand of oakum was caulked into the back of the joint. The joint runner can be made of rope asbestos or of clay, as is sometimes used for lead joints in water mains, but apparently the square face asbestos runner was preferred.

When leaks occurred it was found possible to make them tight again by heating the joint material at the point of leak by means of a torch until the material just began to flow, then applying more of the compound which had been heated to a plastic condition and pressing it into the joint against the sides of both hub and spigot, then applying the torch again to the surface of the patch until it just began to flow. Patches made in this way were found to be as tight as any other part of the joint.

In one test, four lengths of 4-inch pipe were jointed together and supported at the two ends and the middle forced about 4 inches out of straight alignment. Under 5 pounds pressure leaks appeared at the bottom of the middle joint, but these were immediately stopped in the way described above. A line of three lengths of 8-inch pipe was jointed and carried across the room by two men, one holding each end, and the joints remained tight under 5-pound pressure, and in another test two lengths of 6-inch pipe which were moved after jointing also remained tight.

In one test the oakum was packed loosely in the joint, but this did not interfere with the tightness of the joint. Apparently also it made no difference as to tightness whether the pipe was glazed or unglazed. A joint poured with the compound at the consistency of thin cream leaked at 10 pounds pressure, and another 10-inch pipe in which the compound was poured very slowly leaked slightly at 5 pounds pressure, indicating the necessity of high temperature in the compound when poured.

The tests also included several using cement and sand. The strand of oakum was caulked into the back of the joint, and Portland cement and sand mixed one to one was used for making the joints. In one case where sufficient mortar was not used, after setting 24 hours, leaks did not develop under 3 pounds but did under 6 pounds. In another test where the cement was brought well over the hub of the pipe and extended out 2 inches on the straight length of pipe the joints showed no leakage under 5-pound pressure, but leaked under 15 pounds. A test of 8-inch pipe was made, using neat Portland cement, extending over the hub and 2 inches out along the straight pipe, and one joint leaked at 5 pounds pressure, and all of them as the pressure was increased above 5 pounds.

Of the three bituminous compounds, one contained 57% of total bitumen (soluble in carbon bisulphide), the second contained 49% and the third 41%. Of the remaining insoluble matter, the first had 40% inorganic, the second 47% and the third 50%. The viscosity at 175 degrees C. varied from 29′ 12″ to 10′ 38″ and the melting point from 74 degrees C. to 105 degrees C. The insoluble inorganic matter, which was presumably the mineral matter added to the asphalt, consisted almost entirely of lime (54%) and magnesia (36%) in the material first described above, but in the second and third compounds was largely silica (69% and 82% respectively) with 24% alumina in the second material and 9% magnesia in the case of the third. In other words, the first sample apparently had limestone dust as its principal mineral ingredient, while the other used pulverized sand.

The Portland cement used was Universal and analysis showed about 64% lime, 19% silica, 7½% alumina, 4% iron oxide and the remainder largely magnesia, sulphuric anhydride and matter lost on ignition.

Disinfecting Sewage at Millville

Millville, New Jersey, has been using liquid chlorine as a disinfectant at its sewage disposal plant for several years, with excellent results. Gas is added to the effluent from the sedimentation tank in the amount of 70 lbs. per day. The effluent averages about 1,400,000 gallons per day. Laboratory tests are made almost daily. The reduction of bacteria usually runs about 99% plus. The annual report of the State Board of Health for 1920 stated that the tests showed an absence of B. Coli in 1 c. c.

Recent Legal Decisions

MATERIALMEN'S CLAIMS AGAINST ROAD CONTRACTOR MUST BE CONSIDERED SEPARATELY

The Arkansas Supreme Court holds, Gave v. Road Improvement Dist. No. 3, 240 S. W. 427, that a statute requiring a road contractor to give a bond conditioned that he will pay for labor and materials furnished, and giving right of action therefore in the name of the district gives a separate and distinct cause of action to each person. A person furnishing labor or material under a contract with the contractor or one of his subcontractors has no relation to a person funishing labor or material under another contract. These claims cannot be added together to give jurisdiction, so that an Arkansas circuit court had no jurisdiction on a bond, where the complaint stated 72 separate claims, all except 4 under $100, though the aggregate amount exceeded the jurisdictional requirement.

KALSOMINED WINDOW SASHES AND WIRED GLASS WINDOWS AS A FIRE PROTECTION

Construing an ordinance of the city of New York requiring proprietors of factories to provide, in addition to appliances for extinguishing fires, "fire-doors and other means of preventing fires," the New York Court of Appeals holds, People v. One Hundred and Thirty-one Boerum Street Company, 135 N. E. 327, 233 N. Y. 268, that kalsomined window sashes and wired glass for windows are of a nature and character so similar to fire doors when directed to the purpose of preventing fire that they may be said to be included within the words "other means" as used in the ordinance. A fire-door is not necessarily limited to exterior openings in a building. But, conceding this, it is a fact that it is used for the purpose of closing an opening in a building and of preventing fire from entering and spreading, and a fire-proof window is of a generally similar construction, devoted to the same purpose, and, fairly, an "other means of preventing fires."

The requirement is held to be one which can be complied with without involving structural changes, since the window sashes could be painted or coated with a fire-proof mixture, and a window pane is of such a temporary and changeable character that it cannot be regarded as a part of the permanent construction of the building.

MISTAKE IN ESTIMATE OF AMOUNT OF CONSTRUCTION WORK—RECOVERY ON QUANTUM MERUIT FOR EXTRA WORK REQUIRED BY CHANGES IN PLANS

The New York Court of Appeals, Foundation Co. v. State, 233 N. Y. 177, 135 N. E. 236, holds that a contract and specifications may contain representations as to existing physical conditions, and, if so, a bidder may rely upon them, even though it be provided that he shall satisfy himself by personal inspection and investigation as to their truth, where because of time or situation such investigation would be unavailing (Faber v. City of New York, 222 N. Y. 255); or statements may be made on which the bidder, because of the language of the contract, cannot rely. He may have agreed that he will not. Then if they are made in good faith he takes the risk of their accuracy. If, however, notwithstanding the agreement as to honest mistake, damages might be recovered from the state for misrepresentations, upon which the bidder might rely, a boring sheet furnished by the state was not such a representation, where it formed no part of the plans upon which the contract was based and was not prepared or used for that purpose. It was an independent bit of information or supposed information in the possession of the state, to which the bidder resorted in making the investigations which it was required to make. If it relied upon this paper, it did so at its own risk. The most it could ask for in regard to this information was good faith.

Where a change in the plans and specifications of a dam, made by the state officials, under a reserved power in the contract, necessitated additional pumps and other items of expense, it was held that the contractor might recover on a quantum meruit for the reasonable value of the work performed.

STATUTORY PROVISION FOR ALLOCATING COST OF STREET IMPROVEMENTS

The Kentucky Court of Appeals holds, Mann v. City of Henderson, 240 S. W. 740, that a statute providing for street improvements to be made at the exclusive cost of abutting owners, but giving the city power to provide by general ordinance that part of the cost shall be borne by the city, does not confer on the legislative board of the city the power to relieve the abutting property owners of all liability, and impose the entire burden upon the city.

GROUNDS OF FORFEITURE OF PUBLIC WORKS CONTRACT

The Tennessee Supreme Court holds, City of Bristol v. Bostwick, 240 S. W. 774, that to constitute the expiration or completion of a public contract, the abandonment or default of the contractor must be such as to be legally binding upon him; temporary cessation of or interference with the work, not acquiesced in by the contractor, will not work a forfeiture, for only the existence of legal causes will terminate his rights under the contract.

ACQUIESCENCE BY TAXPAYERS IN UNAUTHORIZED STREET GRADING WILL PREVENT THEIR ENJOINING COLLECTION OF ASSESSMENTS

The Nebraska Supreme Court solds, Kister v. City of Hastings, 187 N. W. 908, that taxpayers who in a petition request the mayor and council to create a paving district, and while the work of constructing the paving improvement is in progress have knowledge that the paving is not being constructed strictly on the established grades, as required by ordinance, but stand idly by and do not protest nor appear befor the mayor and council sitting as a board of equalization, are estopped and cannot maintain a suit in equity to enjoin the collection of special assessments levied to pay the cost of the improvement.

ACCEPTANCE OF BID BEFORE ADOPTION OF ORDINANCE AUTHORIZING CONTRACT

The Texas Court of Civil Appeals holds, Basham v. Holcombe, 240 S. W. 691, that, in the absence of fraud or bad faith, a city council may accept a bid for public improvements before the money therefor is in the city treasury, and before an ordinance authorizing a contract has been adopted, and hold in abeyance the making of a contract with the bidder until that can be done in full compliance with the charter provisions, where the charter does not prescribe the time within which contracts must be let after bids are received.

RETURN TO MUNICIPAL WATER PLANT

The Indiana Public Service Commission holds that the plant of a municipality operating its own water supply system should earn at least enough to pay for operating expenses, depreciation and the annual retirements on the funded debt and the interest charges thereon, provided the annual retirements and interest charges do not exceed what ordinarily would be considered a fair return on a reasonable value of the plant if operated as a private concern. The net income from the water department should be annually covered into the general fund of the city where it would be available for retirements on the funded debt and for the payment of interest charges.

RULE AS TO DEPOSITS FOR WATER BILLS

The Indiana Public Service Commission considers that there is no objection to a municipality operating its own water plant making and filing a rule requiring subscribers to make a deposit to guarantee the payment of bills for water consumed, providing the deposit is reasonable. Such a rule, if made, should be strictly adhered to, and should give the subscriber the option of making a cash deposit or of furnishing a written guarantee. The Commission authorized the City of Connersville to file such a rule, the rule to provide that in case of a cash deposit it should be returned, less any unpaid bill, when service is discontinued, with interest at the rate of 6 per cent. per annum.

COUNTY ROAD CONTRACTORS' BONDS AS PROTECTION TO SUBCONTRACTORS

When a contractor's bond for county road construction is to the Commonwealth of Pennsylvania, for the use of a county and any other corporation or person interested, the bond is not for the sole protection of the county, but also inures to the benefit of any corporation or person furnishing labor or materials in and about the construction of the roadway. It has been ruled in a number of decisions in Pennsylvania Courts that such a bond covers only such materials as enter into or become a part of the visible work which was directed to be done. The primary purpose of including in the contractor's bond such a clause protecting laborers and materialmen, the Pennsylvania Superior Court says, H. R. Robertson Co. v. Globe Indemnity Co., 77 Pa. Superior Ct. 422, is to secure for the construction competent labor and satisfactory material. It is to the interest of the public authorities that this be done; but the inclusion of such a clause does not relieve subcontractors and materialmen from all care in relation to the matter. "If they are to be protected by the provisions of the bond, it is incumbent on them to see that the materials furnished by them are used in and about the construction of the work and not diverted elsewhere, or by the negligence of the contractor suffered to deteriorate and be condemned. To hold otherwise would open the door to covin and fraud to such an extent that it would be difficult to secure such bonds from responsible surety companies."

AMBIGUITY IN RESOLUTION AND PLANS FOR PAVING FATAL TO PROCEEDINGS

Where an immaterial difference exists between street improvement work to be done by the resolution of intention and that described in the plans and specifications, the proceedings will not be rendered void, but the clear provision of the resolution of intention will govern. This rule, however, does not apply to a case where the resolution of intention is ambiguous and contains contradictory provisions. Where plans and specifications for paving, made part of the resolution of intention by reference, called for additional work, it was held, Southwest Paving Co. v. Wilson (Cal. App.) 206 Pac. 776, that an ambiguity was created which rendered the proceeding void. The property owners would have no certain basis upon which to rely, and persons desiring to bid would have no definite starting point from which to reckon. To insure fair competitive bidding, the bids must be for the construction of the same work, not only as to character, but as to extent as well.

COST OF OPERATION OF UTILITY ACQUIRED BY MUNICIPALITY

The Washington Supreme Court holds, Asia v. City of Seattle, 206 Pac. 366, that under Rem. Code 1915, sections 8005, 8006, 8008, authorizing a city to acquire and operate street railways, but prohibiting the incurring of general indebtedness therefor without submitting the question to the voters, the city cannot, without such submission, voluntarily or involuntarily encroach upon its general fund, or otherwise place upon the taxpayers the burden of meeting deficits of any kind incurred by reason of the carrying out of a plan of purchase or the operation and maintenance of a street railway system. If not so submitted, all obligations arising from such acquisition, operation and maintenance of the utility must be met from revenue.

ASSIGNEE OF ENGINEER'S FEE HELD NOT ENTITLED TO RECOVER ON QUANTUM MERUIT

A city made a contract with an engineer for his services as consulting, designing and supervising engineer in the installation of a sewer system for the city. The engineer assigned his rights to the fee provided to be paid him when the contract had been fully performed. The assignee sued the city on a quantum meruit for the reasonable value of services performed. It was held, Cambridge Co. v. City of Elsinore, (Cal. App.) 206 Pac. 1021, that the assignee acquired no right other than the right to such fee as might become due to the engineer under the terms of his express contract with the city; and that as the engineer never became entitled to such fee, he having failed substantially to perform his contract, the assignee could not recover on a quantum meruit the reasonable value of the engineer's partially performed services.

NEWS OF THE SOCIETIES

CALENDAR

Sept. 11-15—ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. New Auditorium, Cleveland, Ohio.

Sept. 12-15—NEW ENGLAND WATER WORKS ASSOCIATION. 41st annual convention. New Bedford, Mass. Secretary, Frank J. Gifford, Tremont Temple, Boston, Mass.

Sept. 14-16—AMERICAN ASSOCIATION OF PORT AUTHORITIES. Convention at Toronto. Secretary, M. P. Fennell, Jr., Montreal.

Sept. 19-23—LEAGUE OF CALIFORNIA MUNICIPALITIES. Annual convention, Palo Alto, Cal. Executive secretary, W. J. Locke, Pacific Bldg., San Francisco.

Sept. 25-28—SOUTHWEST WATER WORKS ASSOCIATION. Annual convention, Hot Springs, Ark. Secretary, E. L. Fulkerson, Waco, Tex.

Sept. 30—NEW YORK SECTION, AM. WATER WORKS ASS'N. Meeting, Utica, N. Y. Secretary, Burt H. Hodgman, 50 Church St., New York City.

Oct. 2-6—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention, Cleveland, Ohio. Secretary, Charles C. Brown, St. Petersburg, Fla.

Oct. 4-9—AMERICAN SOCIETY OF CIVIL ENGINEERS. Fall meeting, San Francisco, Cal., Palace Hotel. Secretary, John H. Dunlap, 33 West 39th St., New York.

Oct. 9-10—INTERNATIONAL ASSOCIATION OF STREET SANITATION OFFICIALS. Annual conference, Chicago, Ill., Hotel La Salle. Secretary, A. M. Anderson, Chicago.

Oct. 16-19 — AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting, Chicago, Ill. Secretary, A. W. Hedrick, 370 Seventh Ave., New York, N. Y.

Nov. 14-16—NORTH CAROLINA SECTION, AM. WATER WORKS ASS'N. Annual meeting, Gastonia, N. C. Secretary, Thorndike Saville, Chapel Hill, N. C.

Nov. 15-16—NATIONAL INDUSTRIAL LEAGUE. Annual meeting. New York City. Secretary, J. H. Beck, Chicago.

Dec. 7-13—NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING. New York City.

AMERICAN SOCIETY OF CIVIL ENGINEERS

The fall meeting will be held at San Francisco on Oct. 4th to 9th, at the Palace Hotel. The preliminary program is as follows.

Wednesday, Oct. 4—9 a. m., get-together; 10 a. m., technical papers; 2 p. m., local excursion; 8 p. m., technical papers.

Thursday, Oct. 5—9 a. m., get-together; 10 a. m., technical papers; 2 p. m., local excursions; 6: 30 p. m., dinner and smoker.

Friday to Monday, Oct. 6-9—Excursion to Don Pedro, Hetch Hetchy and Yosemite Valley. Those who do not wish so long an excursion may return directly from Hetch Hetchy to San Francisco Sunday.

The special excursion rates, including Pullman, are: Boston, $215.18; New York, $203.58; Chicago, $133.26.

INTERNATIONAL ASSOCIATION OF STREET SANITATION OFFICIALS

Because of the change made by the American Society for Municipal Improvements of its convention date from the week of October 9 to that of October 2, the International Society of Street Sanitation Officials has changed the date of its Chicago convention to October 9 and 10, as some of the members wished to attend both meetings. President W. J. Galligan announces that it is proposed to hold morning and afternoon sessions on Monday, October 9, and on Tuesday, as guests of the city of Chicago, take a trip by boat to the locks of the Sanitary Canal.

NEW ENGLAND WATER WORKS' ASSOCIATION

The 41st annual convention of this association will be held at the New Bedford Hotel, New Bedford, Mass., on September 12th to 15th. The technical sessions and manufacturers exhibit will be on the top floor of the hotel. The program is announced as follows:

Tuesday Morning, 10 o'clock.

Address of welcome by Mayor W. H. B. Remington.

"Description of the New Bedford Water Works and Experiments with Substitutes for Lead in Jointing Cast Iron Pipe," by Stephen H. Taylor, superintendent New Bedford water works.

Wednesday Morning, 9 o'clock.

"Co-operation," by Francis T. Kemble, secretary New Rochelle Water Company.

"Why We Should Inspect Water Works Equipment," by Thomas E. Lally, assistant engineer, Public Works Department, Boston.

"The Quality of Water and Its Relation to the Life and Proper Operation of Service Pipes and Plumbing Appliances," by David A. Heffernan, superintendent, Water Works, Milton, Mass.

Wednesday Afternoon, 2 o'clock.

"Pumping by Electricity at Concord, N. H.," by Percy R. Sanders, superintendent, Water Works, Concord, N. H.

"Experiences with a 35-Year Old Steam Pump," by Fred O. Stevens, engineer and superintendent, Water Works, East Weymouth, Mass.

"Should the Water Department be Merged with Other Municipal Departments in Its Management and Finances?" by George A. King, superintendent, Water Works, Taunton, Mass.

Wednesday Evening, 8 o'clock.

"Some Observations on Cross-Connections for Private Fire Protection," by Caleb M. Saville, chief engineer, Board of Water Commissioners, Hartford, Conn.

"Some Experiences in Meter Setting and Maintenance," by James A. McMurry, assistant engineer, Public Works Department, Boston.

"Legal Points in the Purchase of a Water Company," by Henry A. Symonds, engineer, Boston.

Thursday Morning, 9 o'clock.

"The Water Supplies of Southeastern Massachusetts," by X. H. Goodenough, chief engineer, Massachusetts Department of Health, Boston.

"The Water Supply of Fall River," by H. K. Barrows, consulting engineer, Boston.

Thursday Afternoon, 4 o'clock (on the boat).

"A New Method of Purifying Water," by Harry W. Clark, chief chemist, Massachusetts Department of Health, Boston.

"The New Water Supply of Providence," by Frank E. Winsor, chief engineer, Water Supply Board, Providence.

Friday Morning, 9 o'clock.

"The Boston High Pressure Service and a Discussion of Variations in the Design of other Systems," by Frank A. McInnes, engineer, Water Division, Public Works Department, Boston.

"High Pressure Fire Systems from the Underwriters' Viewpoint," by Geo. W. Booth, chief engineer, Board of Fire Underwriters, New York.

"Short Statements from Several Fire Chiefs on Value of High Pressure Service from Fire Fighters' Viewpoint"

Friday Afternoon, 2 o'clock.

"Sanitary Dangers to Water Supplies," by E. Sherman Chase, engineer, Boston.

"Application of Copper Sulphate to Hartford Reservoirs and Some Effects on the Length of Filter Runs," by J. E. Garrett, office engineer, Board of Water Commissioners, Hartford.

"An Elementary Discussion of the Hydrogen-Ion Determination and Its Significance," by Robert Spurr Weston, consulting engineer, Boston.

Entertainments:

Tuesday afternoon, automobile ride to Quittacas pumping station, lunch there and then visit reservoir and other parts of system.

Tuesday evening—informal reception with dancing at hotel.

Thursday afternoon—excursion by steamer on Buzzard's Bay and by trolley to Fort Phoenix, where clam bake will be served.

NORTH CAROLINA SECTION, AMERICAN WATER WORKS ASSOCIATION

The annual meeting of this section will be held in Gastonia, N. C., on November 14, 15 and 16, in the new filtration plant of the Gastonia water works. There will be an exhibition of manufacturers' apparatus and appliances, as well as papers and discussions. In addition to the filtration plant, the activated sludge sewage treatment plant will be interesting for inspection. The convention will open Tuesday

evening with a banquet, an address of welcome by the mayor and a response and annual address by the president, J. L. Ludlow. The time and place for the next meeting will be selected.

Wednesday morning, J. O. Craig of Salisbury will read a paper entitled "Water Works Accounting — Water Rates." "Experience with Woodstave Pipe in Greensboro," by M. N. Boyles, and "The Gastonia Water Purification Plant," by J. H. Rhyne, will be read and a discussion of the latter will be given by F. W. Simons and an inspection of the plant made.

Wednesday afternoon the following papers will be read: "Operation and Care of Chlorine Control Apparatus" by P. J. Dishner, discussed by a representative of Wallace & Tiernan. "Uses of Deep Well Water to Secure Additional Alkalinity for Treating Surface Water," by J. C. Womble of Washington, D. C. "Laboratory Control of Filtration," by Geo. D. Norcom. "Economical Control of Chemical Dosage in Filter Plants," by R. A. Maddock. "Operation of Small Filter Plant," by R. F. Ward. "The Importance of Filter Sand and Gravel in Filtration Plants," by A. O. True. "Use of Oxy-Acetylene Torch in Water Works Practice," by J. C. Michie. "Experience with Pipe Cleaning Machines," by J. C. Michie, with discussion by representative of the National Water Main Cleaning Company. "A New Form of Pipe Joint," by Thorndyke Saville. "Air Lift Pumps for Deep Wells," by a representative of the Gould Mfg. Company, with discussion by P. W. Pressley, C. W. Lee and others.

Wednesday evening the following papers: "A Water Works Superintendent's Responsibility for Fire Fighting," by a representative of the Underwriters' Association. "The Operation and Care of Electric Motors for Pumping Units," by E. E. Williams. "Algae Growth in Reservoirs," by L. H. Shaner, with discussion by E. E. Williams. "Experience with Universal Pipe," by A. McK. Maffitt, with discussion by Mr. Bennett.

Thursday morning the following papers will be read: "Reduction of Consumption by House to House Inspection," by A. McK. Maffitt, with discussion by E. B. Bain. "A Simple Water Works Accounting System," by C. M. Whitlock. "The Underground Water Resources of North Carolina," by Col. J. H. Pratt. "Combustion of Coal in Boiler Furnaces," by A. McK. Maffitt. "The Problem of Cross Connections and Charges for Private Fire Protection," by W. J. Alexander. "The Gastonia Sewage Treatment Plant," by J. H. Rhyne and William Piatt, followed by an inspection of the plant. "Practical Use of Hydrogen-Ion Determinations," by W. S. Thereault. Round table discussions of "Unusual Peaks in Consumption"; "Service Connections to Mains Without Lead Joints"; "Substitutes for Lead Joints in Cast Iron Pipes"; "Accounting"; "Rates"; "Metering"; and "Distribution Problems."

The secretary-treasurer of the section is Thorndyke Saville, Chapel Hill, N. C.

PERSONALS

Mellen, Arthur F., assistant superintendent of filtration for the Minneapolis Water Works Department, will succeed Lewis I. Birdsall in charge of the Minneapolis filtration plant. Mr. Mellen is Secretary of the Engineers' Club of Minneapolis.

Johnson, Col. George A., has been retained to plan and supervise the construction of improved sewage disposal works for Trenton, N. J.

Burroughs, P. E., District Engineer of the State Road Commission of Maryland, has resigned and associated with Mr. D. A. Hanneman Construction Company of Salisbury.

Eby, Earl H., formerly district engineer with the South Dakota Highway Commission, has been promoted to the position of construction engineer with headquarters at Pierre.

NEW CATALOGS

(If you want any of these catalogs send the number with your name and address to PUBLIC WORKS and it will be sent to you promptly without charge or obligation.)

WATER WORKS AND POWER PLANT SPECIALTIES

451. McAlear Mfg. Co., 1901 S. Western Avenue, Chicago, Ill. 128 page catalog, No. 27, specialties for power plants, oil refining and water works plants, plumbing systems and marine service described in detail.

ROAD RAZER CIRCULAR

453. The Avery Company has just issued a circular advertising their one-man power lift road razer, stating that more than 100 representatives driving these appliances will visit communities throughout the country, demonstrating the value of the machines for smoothing rough roads.

EXCAVATOR AND LOADER

454. The T. L. Smith Company, Milwaukee. Four page leaflet describing the use of the Smith Excavator and Loader, by which cellars, sand pits, etc., are excavated without either machine or wagon going into the hole.

USICAST PRODUCTS

455. U. S. Cast Iron Pipe and Foundry Company. A pamphlet containing photographs of the various works of the company in New Jersey, Ohio, Tennessee and other states; also showing interesting illustrations of its products.

REDUCING ULTIMATE CULVERT COSTS

456. Pamphlet 3½ inches by 6 inches. Setting forth the merits of cast iron as manufactured by the U. S. Cast Iron Pipe and Foundry Company for use in highway culverts.

WATER, GAS AND FLANGED PIPE

457. National Cast Iron Pipe Company. A catalog of cast iron pipe and fittings containing the A. W. W. A. standard specifications, with standard dimensions; also the A. G. I. standard specifications for gas pipes. 80 pages.

REFUSE DISPOSAL IN SMALL COMMUNITIES

458. Balmer Corporation. Describes plants used in hospitals and small communities.

TRADE STANDARDS IN PUMP INDUSTRY

459. Pamphlet of 21 pages giving the standards of manufacture, of definitions of terms, and of customs in the pump industry, as recommended by the Hydraulic Society, which is composed of the Worthington Pump and Machinery Corp., Goulds Mfg. Co., DeLaval Steam Co., and 25 other pump manufacturers.

ONE HOUR AND FIFTY-SEVEN MINUTES

460. The Koehring Company. A 3-page leaflet giving the record of a Koehring paver with time out of service of one hour and fifty-seven minutes in three seasons.

NOVO POWER

461. The Novo Engine Company. Eight-page pamphlet describing Novo hoists, saw rigs, and other uses for Novo engines.

STREET LIGHTING

462. Folder entitled "Turning Night Time Into Day Time," describing some of the Westinghouse Electric Company's street lighting fixtures, with illustrations. 12 pages.

WILLIAMS' ELECTROLYTIC CELL

463. Electrolytic Chlorine Company. Kansas City, Mo. 12-page pamphlet describing manufacture of chlorine in small quantities for water sterilization.

CENTRIFUGAL PUMPS

464. Pennsylvania Pump & Compressor Company, Easton, Pa. A new 16-page bulletin No. 202, describes the company's line of double suction, single stage centrifugal pumps. Contains useful engineering data.

DRESSER STEEL PIPE COUPLINGS

465. S. R. Dresser Mfg. Co., Bradford, Pa. Folder describing couplings for pipe lines, especially water pipes, either steel or cast iron.

BERMUDEZ ROAD BOOK

467. Barber Asphalt Co., Philadelphia, Pa. A 16-page booklet, well illustrated, describing special advantages of Barber asphalt for road work.

New Appliances

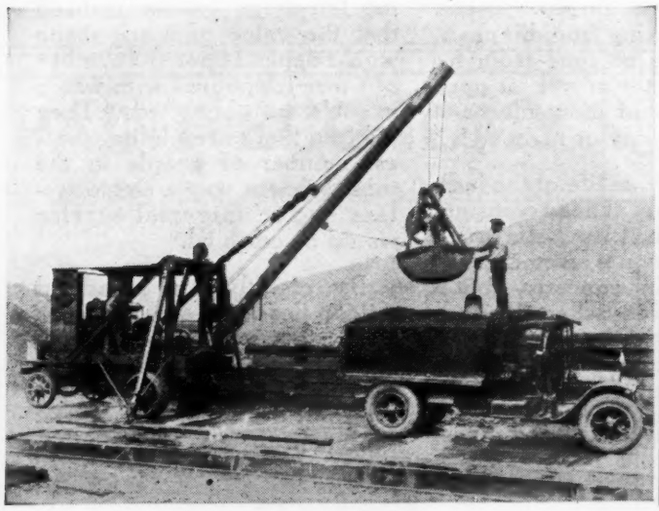
Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

BYERS TRUCKRANE

A crane mounted permanently on a motor truck, which can be driven from the garage to the job every morning and from one job to another, is being put on the market by the Byers Machine Company under the name of the "Byers Truckrane." The manufacturers believe that it will be the ideal equipment for general contractors, counties, municipalities and industrial plants.

The crane unmounted weighs 6 tons and is similar to Byers Auto-Crane model No. 1 in every respect except that it has no wheels, jack shaft, or differential and drive chain. It has a power drum for raising and lowering the steel boom. The crane is furnished with a Hercules' 4-cylinder 4"x5" engine developing over 30 horsepower, operated by gasoline power. Any half-cubic-yard bucket weighing not over 2,000 pounds can be used with it.

The crane can be mounted on any truck, even an old one that has seen 90 per cent. of its usefulness if the motor is capable of turning over. Bargains in half-worn out motor trucks can be had everywhere which will permit obtaining a complete outfit at extremely reasonable cost.



BYERS TRUCKRANE

FOUR-WHEEL-DRIVE FIRE TRUCK

The most recent tractor truck to enter the fire department field is the F. W. D., manufactured by the Four-Wheel-Drive Auto Company. This tractor has a 105-inch wheel base, a 4-cylinder Wisconsin motor which develops a horsepower of about 65 and is capable of driving the tractor and load at about 25 miles per hour. Newark, N. J. recently motorized two of its hook and ladder trucks by removing the front wheels and axles of the horse-drawn truck and mounting the front end of the bodies on F. W. D. tractors by means of a fifth wheel.

PREPARED JOINT PIPE

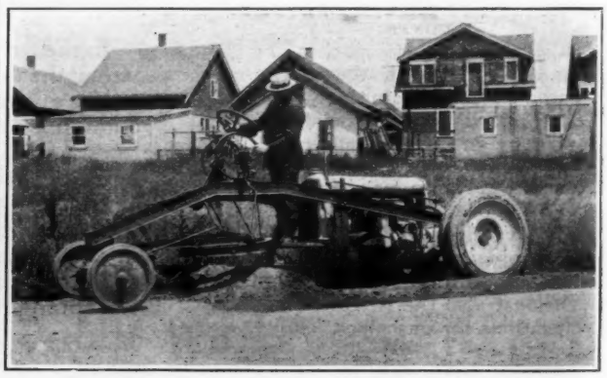
What is known as the "Simplex Prepared Joint Pipe" has been placed on the market by the American Cast Iron Pipe Company. The pipe is manufactured in 5-foot lengths and in sizes of 2", 3", 4" and 6" diameters and designed for working pressures up to 150 lbs. The joint has a prepared gasket made in one piece to be slipped onto the male end of the pipe just prior to coupling it up. Bolt flanges are provided, and by means of bolts the two lengths of pipe are drawn together and the gasket wedged into the stuffing box when the bolts are tightened. The gasket is made of different materials for different services. For water and gas, it is made of lead and jute. For oil, vapor and acid, asbestos is used. For certain other services, rubber is used.

The pipe is found serviceable for industrial water supplies, water and gas service lines, filtration plants, refrigeration, sewage disposal and other purposes. The gasket, being a flexible, yielding, but homogeneous material between the metal surfaces, permits longitudinal and lateral deflections, with no severe strain or stresses. Fittings such as crosses, tees, bends, reducers, etc., are made with the same joint fittings. Threaded couplings are furnished for connecting "simplex" construction to existing lines.

ONE-MAN POWER GRADER

The Wehr one-man power grader is designed to meet the requirements of maintenance work in city streets and country roads and also furnishing work and light grading for contractors. The standard Fordson tractor is the power unit, which enables the user to get quick service on any motor part in any part of the country. The grader is constructed with a heavy steel channel frame carrying a 6-foot blade, which is used for finishing work and grading. The blade can be raised or lowered or tilted at any angle desired by the operator.

The motor is swung on a three-point suspension so that no unnecessary strains are put on the power unit. The weight of the power unit is utilized to hold the grader steady on the road when working, for which reason this machine will do more work than any other light-type machine on the market, where the power is utilized ahead of the cutting blades. It is claimed that, used as a maintainer, this grader will do three times the work of any horse-drawn equipment or of any light-power maintainers now on the market.



WEHR ONE-MAN POWER GRADER

THE TRAIL-FORD

A two-wheel trailer designed to connect directly to the rear axle housing of a Fordson tractor through adaptor castings which clamp solidly to grooves in the housing, immediately inside the wheels, has been brought out by the Automotive Utilities Corporation. The adaptor castings are cast iron bushings designed so that the steel clamps that encircle same may swivel radially on the adaptor castings. This eliminates all wear on

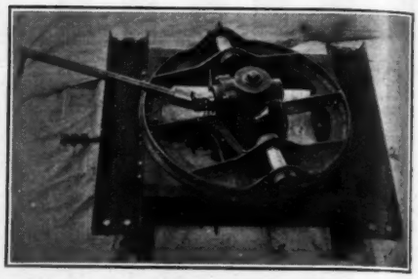
axle housing as it throws wear on adaptor castings which may be quickly and cheaply replaced.

The wish bone and main frame are pivotly mounted through a king plate. The construction of the king plate eliminates the wear on the pivot bolt. There is no shear whatever on this bolt as the draw bar pull, strain, and stress is entirely taken care of by the king plate. The king bolt merely acts as a tension member to hold parts together.

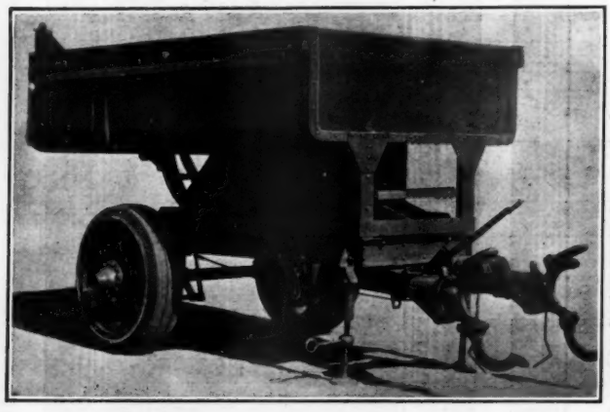
The wishbone is constructed of 5-inch standard channels and steel castings. On each of the forward ends of the wishbone are mounted the steel spring cushioned clamps which connect the trailer to tractor, making them one unit. At the point of the wishbone a 6-inch roller is mounted. The roller is carried on a 3/4-inch ball bearing and rolls between the flanges of a channel iron quadrant placed transverse of the main trailer frame. Its function is to carry the rear end of the wishbone which carries 75 per cent. of the load through the king plate and main frame of the trailer.

The wishbone is so constructed and connected to the main frame of the trailer as to allow the tractor to turn either right or left without turning the main frame of the trailer until it comes to the point where the tractor started to make its turn. This produces the only two-wheeled trailer of the dead axle type that will follow in the same tracks of the towing vehicle.

The main frame is 3 ft. wide and 7 ft. long, constructed of 6-inch standard channels and balances on trailer axle so that a 3-yard gravity side or end dump body, a 6x10 platform body, or hayrack may be mounted thereon.

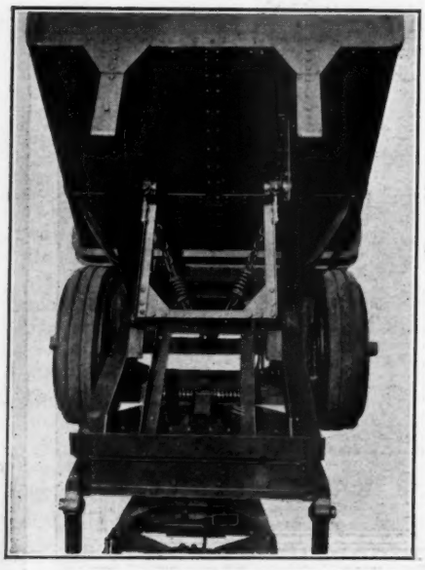


POWER TRANSMISSION GEARS IN GEAR HOUSING ATTACHED TO FIFTH WHEEL.



VIEW OF TRAILFORD TRAILER DISCONNECTED FROM TRACTOR.

WARNER SEMI-TRAILER IN SERVICE.



BODY RAISED FOR DUMPING.

WARNER SEMI-TRAILER

A firm in a large Illinois city using more than 150 7-1/2-ton trucks, which did a large amount of hauling outside of the city found that the state law, which was being rigidly enforced, limited the weight of vehicles and loads to 32,000 lbs. with a limit of 16,000 lbs. over any one axle, which would restrict them to carrying less than 4-1/2 tons of live load on 7-1/2-ton trucks. Engineers of the Warner Mfg. Co. were appealed to and developed a semi-trailer by use of which they could haul at least 10 tons without putting more than 16,000 lbs. on the driving axle. Moreover, as the law permitted an additional 24,000 lbs. total weight, including the load, if a trailer with separate axle and separate set of wheels is used and the total weight per inch of tire width does not exceed 800 lbs., the company developed a trailer rated at 15 to 18 tons, which weight can be carried where the law is not rigidly enforced, or 10 tons where it is enforced. Thus, with an investment of less than $2,000 and practically no additional operating expense, the trucking company can haul a minimum of 10 tons live load where, without the semi-trailer, they were limited to 4-1/2 tons of live load. There is such a liberal margin of tire surface that the destructive action of the truck on the highway is less carrying 18 tons than it was formerly carrying 10 tons.

The company claims special advantages for certain of the details of this output, such as transmitting the truck power through the fifth wheel of the semi-trailer into the hoist by mechanical rather than hydraulic hoist. The driver from the cab can throw the hoist in or out at any point. The fifth wheel is so mounted as to give complete freedom of action of the trailer frame both horizontally and vertically.

IDEAL SEWER JOINT COMPOUND

An asphaltic compound prepared for making water tight joints in vitrified sewer pipe is manufactured by the Waring-Underwood Company. The compound is poured at a temperature of about 400 degrees, joint runner or "snake" being used on the joint as in pouring a lead joint. It should be melted in a small roofing kettle or lead melting furnace and handled with a dipper that has a capacity just a little in excess of the material required for one joint. An illustration is cited where this joint was used in laying 6-inch pipe that operated under a head of 44 feet. In a test length of pipe so jointed, the pipe itself burst at 55 lbs.

Independent Concrete Pipe being installed for City of Monroe, Michigan

Concrete Pipe is a tried and tested material

DURABILITY

There is no question, nor has there ever been any question about the durability of Reinforced Concrete Pipe. Concrete pipe gives utmost satisfaction wherever it is used for sewers, drains or culverts.

Engineers know that they can place dependence in the sewer that has been installed with this material. Concrete pipe will answer every purpose that the project may demand. The strength of concrete increases with age.

CONCRETE PIPE MEANS PERMANENT CONSTRUCTION

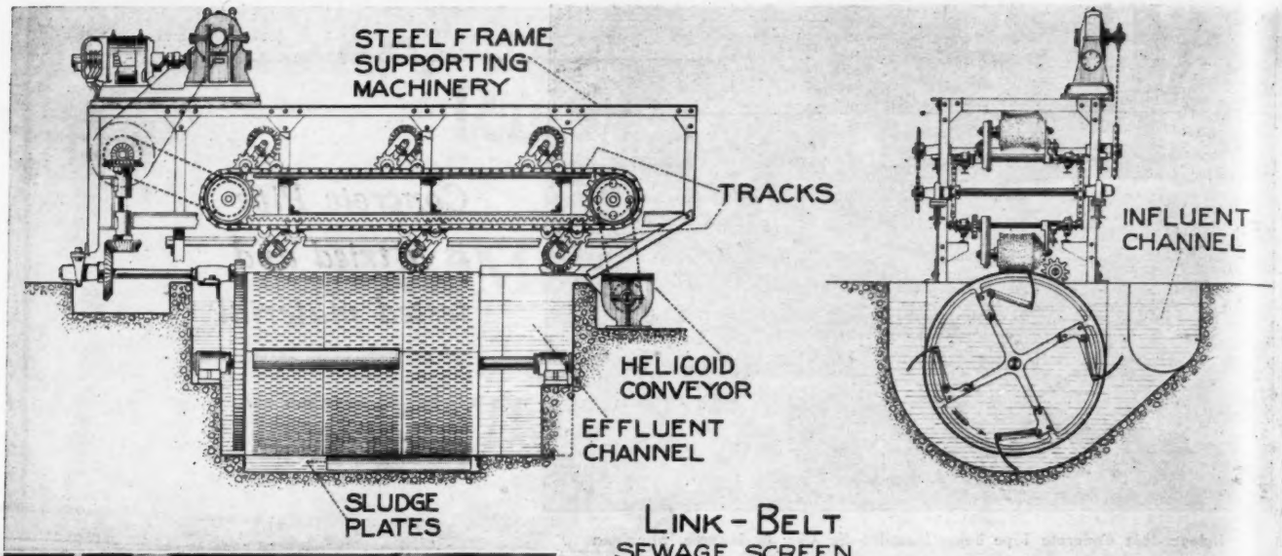
Concrete pipe is true to shape, provides smoothest flow line, gives maximum carrying capacity and greatest service.

Easy to Lay—Cheaper to Lay Faster to Lay

Consult us for prices and other data before bidding on your next work

INDEPENDENT CONCRETE PIPE CO.

INDIANAPOLIS, IND.

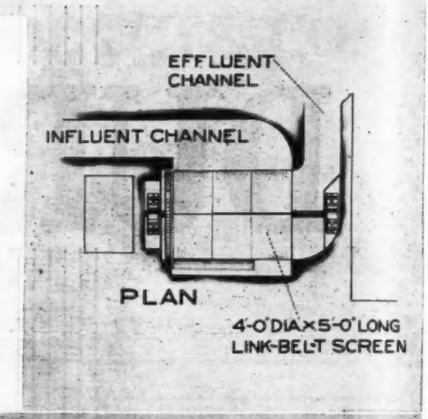


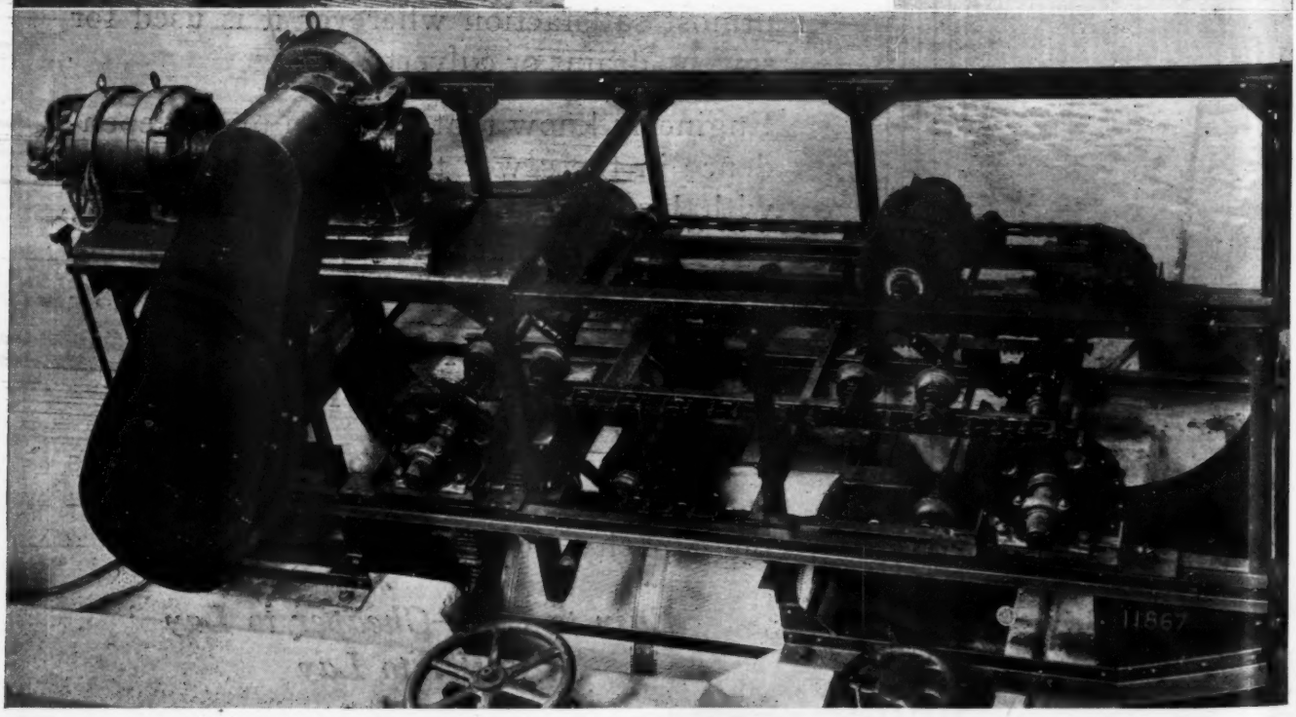
LINK-BELT
SEWAGE SCREEN
--4'-0" DIA. X 5'-0" LONG--

Above: Diagrammatic View of Screen.

Left: Close-up View of Brush.

Below: Longitudinal View of Screen.





LINK-BELT

The Link-Belt Sewage Screen

For the Clarification of Municipal and Industrial Sewage

THE Link-Belt Sewage Screen (patented) consists of a slowly revolving cylinder arranged to pass the material through the screening surface from the outside inward, in combination with revolving brushes carried forward longitudinally overhead, in contact with the screening surface, rotating in such a direction as to sweep the screenings forward and discharge them at the end of the cylinder for removal.

The screen surface is made of bronze plates with narrow perforations running parallel with the axis, or of straight parallel wires strung closely together, according to the work to be done. Either arrangement favors the action of the brushes in cleaning. Each brush is adjustable in height, and its weight does not rest on the screen surface.

Brushes may be added as required, and the outfits are built in capacities from 2.5 to 38 cubic feet per second.

Advantages

Low first cost.

Low cost of operation and maintenance.

Largest percentage of submerged screening surface. As high as 95% of the total screen area may be submerged.

Great flexibility in design. Wide variations of level may be obtained with any volume of flow.

A perfect cleaning device.

Perfect adjustment of each individual brush. No useless work by brushes, no unnecessary weight on brushes—means long life of brushes.

Great strength and rigidity. A cylinder is the strongest possible shape.

A balanced machine at all levels and under all heads.

Greatest accessibility and cleanliness, every part may be inspected and cleaned during operation.

The loss of head, counterbalances the weight of the machine. No more power is required at high than at low levels.

A Link-Belt screen has now been in operation for over twelve months at the Sewage Treatment Plant, Pleasantville, N. J. During this time, not a cent has been spent on repairs.

Send for further particulars.

1023

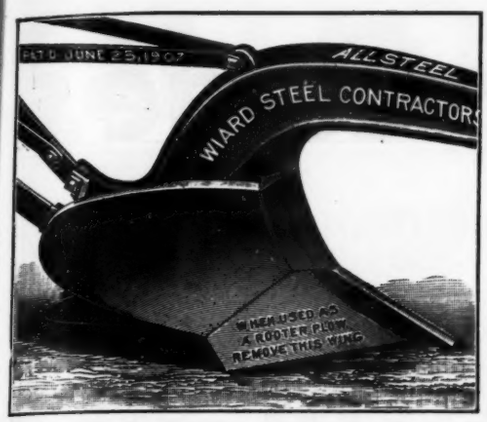
LINK-BELT COMPANY

PHILADELPHIA CHICAGO INDIANAPOLIS

New York - - Woolworth Bldg. Wilkes Barre - - 2d Nat'l Bank Bldg. Seattle - - - 820 First Ave., S. Louisville, Ky. - - F. Wehle, Starks Bldg.
Boston 9 - - - 49 Federal St. Huntington, W. Va. - Robson-Prichard Bldg. Portland, Ore. - - - 101 First Sts. New Orleans - - C. O. Hine, 504 Carondelet Bldg.
Pittsburgh - - - 1501 Park Bldg. Cleveland - - - 429 Kirby Bldg. San Francisco - - - 163 Second St.
St. Louis - - Central Nat'l Bank Bldg. Detroit - - - 4210 Woodward Ave. Los Angeles - - 163 N. Los Angeles St. Birmingham, Ala. - - -
Buffalo - - - 647 Ellicott Square Kansas City, Mo. - - 306 Elmhurst Bldg. Denver Lindroth, Shubert & Co., Boston Bldg. S. L. Morrow, 720 Brown-Marx Bldg.

Canadian Link-Belt Co., Ltd., Toronto and Montreal H. W. CALDWELL & SON CO., CHICAGO NEW YORK, Woolworth Bldg. DALLAS, TEXAS, 709 Main St.

LINK-BELT



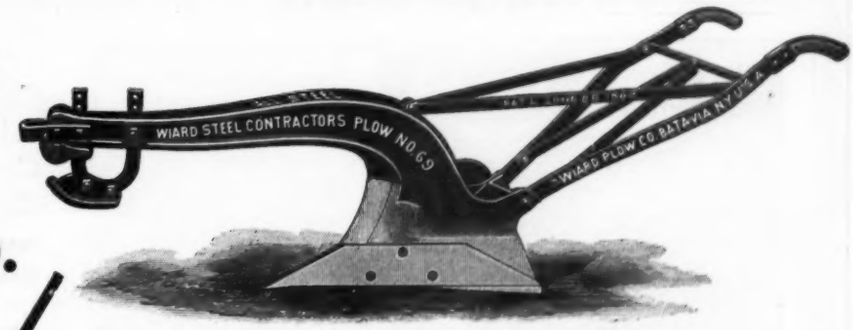
WIARD TWO IN ONE PLOW

A highly recommended plow for heavy excavating and all kinds of contractors' work, "Good Roads" work and all cases where great strength and capacity are required.
Rips up cobblestones and macadam with the greatest ease. Hitch it to a road roller, tractor, oxen or horses. Remove the steel wing as shown above and you have a perfect rooter.
The Wiard line of contractors' plows fill every need and every plow is guaranteed.

A Perfect Rooter

Large Capacity
Light in Weight
Great Strength
Excellent Turning Qualities

Wiard Plow Co.
BATAVIA, N. Y.



No. 69 (All Steel) Contractors' Plow, Landside View

You'll Have To Admit This Is Some Smooth Ditch-Deep Too!

The picture shows the excellent road work accomplished with Russell Road Machines—taken in Travis County, Texas—and Texans know that their road problems demand unusual efficiency. Here "Russells" lead as they do in other states—easily the most numerous and doing the best work.

Russell Equipment covers everything needed for road construction, road maintenance and road repairing including Road Drags, Dump Wagons, Culverts, Steel Beam Bridges, etc.

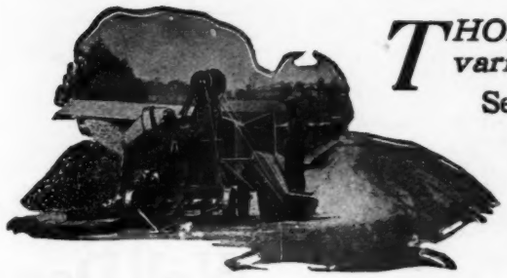
RUSSELL GRADER MANUFACTURING CO.
FACTORY AND GENERAL OFFICES—MINNEAPOLIS, MINN.
Affiliated Plants—Cicero, Ill., North Kansas City, Mo., Memphis, Tenn., Dallas, Tex.

A very complete catalog for Road Builders sent free.

RUSSELL
ROAD EQUIPMENT

OHIO Repeats on Jaegers

Jaeger
A MIX A MINUTE



THOROUGH satisfaction with a product invariably brings repeat orders.

Several years ago Ohio standardized on Jaeger Mixers for her road work. After careful tests she found that this sturdy outfit handled her highway concrete work ***quicker, better and at less cost than any other make of mixer.*** And since that time, each year—in open competition with other mixers—Jaegers have always been chosen in Ohio.

This year, as before, competing with practically every standard make of mixer, Jaeger again was selected by the Buckeye Commissioners as the mixer for Ohio. They placed an initial order for 14 Jaeger Mixers.

"JAEGER" Means Tilting Drum

There's coming to be a country-wide preference for the Jaeger "Mix a Minute" Mixer for road work. Especially for cold patching work it is admirably adapted. Its tilting drum discharges the sticky material as easily as it does the wettest concrete. In fact, a tilting drum mixer is ***the only practical mixer for cold patch work.***

It saves labor, saves material—does a better job. For quick, low-cost work on culverts, abutments and the like, it is unexcelled.

And this same tilting-drum feature is one of the big reasons why more than 13,500 building contractors prefer the Jaeger to any other mixer. On the largest skyscraper or the smallest sidewalk job, this sturdy tilting-drum outfit will ***turn out the concrete faster and at lower cost*** than any other mixer in its class.

IF YOU WANT A MIXER THAT WILL WORK ITS WAY TO PROFIT ON EVERY CONCRETE JOB YOU DO — *YOU WANT A JAEGER.*

The Jaeger Machine Co., 400 Dublin Ave., Columbus, Ohio

Jaeger 4-L

Jaeger makes 18 different mixer outfits—***the most complete line offered under one name.*** Simplicity is the keynote of Jaeger construction. Such simplicity means less power to operate, small upkeep, low depreciation and long life.

Jaeger 4-E

The coupon will bring you the profit-story of the Jaeger line of mixers. You'll be interested in the new low prices. Mail the coupon today.

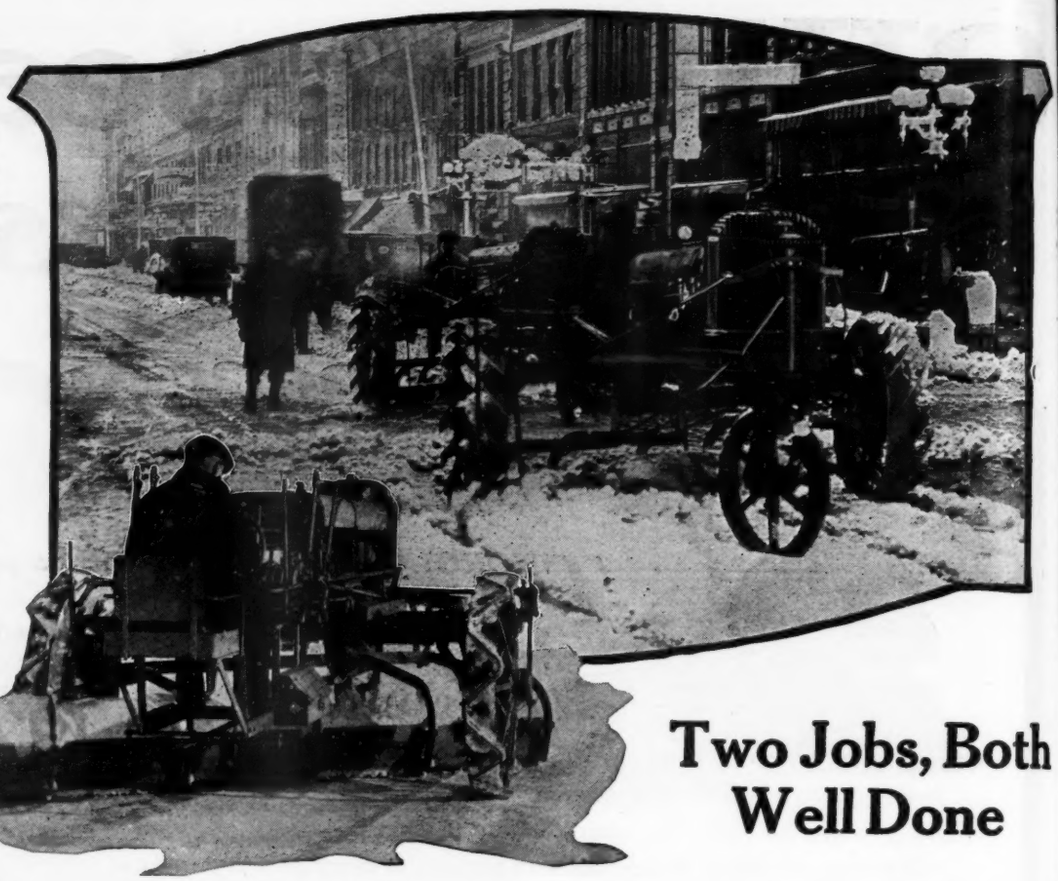
The Jaeger Machine Co.,
400 Dublin Ave., Columbus, Ohio.

Please send me more facts on the Jaeger line of Mixers.

Name _____

Address _____

_____



This photograph of the main business section of Salina, Kansas, was taken immediately after a heavy snowstorm. Notice how thoroughly the Avery "ROAD - RAZERS" are clearing the snow off the street.

Here is the Avery "ROAD-RAZER" cleaning the surface of the municipal skating pond. Just one of the many ways in which this wonderful "two-job" machine can be utilized.

Two Jobs, Both Well Done

Removing Snow—Maintaining Unpaved Roads and Streets

THINK of a machine you can keep busy all year 'round, shaving the roughest roads and streets smooth—doing more, faster and better work at lower cost than has ever been possible with any other method—then when snow fills your streets, removing it for you quickly, easily and at low cost. That's the Avery One-Man "Road Razer"—the most successful machine ever designed for country road and unpaved street maintenance work.

Mr. L. P. Alber, Commissioner of Public Improvements, Great Bend, Kansas, writes: "Your representative dropped in here during our big snow last year and got the "Razer" out and went to work showing us how to clean snow off our streets. The machine did the best job of cleaning off snow from the streets that we ever saw done by any machine. We bought it and as soon as the snow went off, we put it right to work smoothing up the streets and it does an elegant job. Our man had no trouble at all in learning the operation of same. We are highly pleased with it."

Mr. Ed. Buchanan, Street Commissioner of Salina, Kansas, writes: "On Nov. 23, I wrote you in regard to how well we liked our Avery Road-Razer for working dirt streets. Now, we have found another use for it, cleaning snow off our streets. We find it a great machine for cleaning off the snow. It does it so nice and clean that the streets are dry in a short time. One man can clean off miles of streets in a day after a heavy snow at a very little expense. It's the best snow machine we ever saw."

Every one interested in public improvement should study the remarkable work of this machine. It has really created a sensation wherever it has been introduced. One man operates it—turns the machine in its tracks, or backs up at will—and raises or lowers the long, flexible, three-section blade to fit and shape any crown or surface of the road.

Sold on approval, subject to demonstration and strongly guaranteed.

Build your roads with Avery Road Tractors and then keep them smooth and clear with Avery "Road-Razers." Write today for prices and complete information.

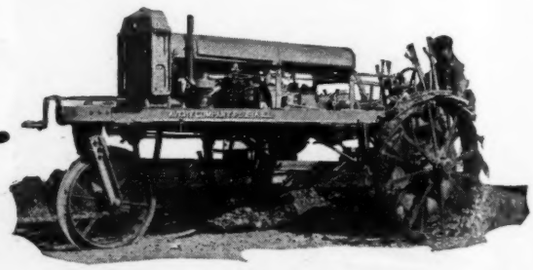
AVERY CO., 225 Iowa St., Peoria, Illinois

Branch Houses: Madison, Fargo, Omaha, Minneapolis, Grand Forks, Sioux Falls, Aberdeen, Billings, Lincoln Sidney, Neb., Des Moines, Indianapolis, Columbus, Kansas City, Wichita, Salina, Stuttgart and Sacramento

Distributors: Avery Company of Texas; Dallas, Amarillo and Beaumont, Texas. *Also Other Principal Machinery Centers*

AVERY

Road-Building, Maintenance and Hauling Machinery



The Avery "ROAD-RAZER" turns the ruttiest roads into a smooth boulevard by shaving off the bumps and ridges and filling in the low places. Does more and better work than several men with teams and **at less than half the expense.**

The "Caterpillar's" field of usefulness is by no means limited to civic and public works. There is a "Caterpillar"* of size and capacity for every power need. On farm or ranch, in the mining, oil and lumber industries, for snow removal, wherever tractive power and endurance are at a premium, the "Caterpillar"* has no real competitor.*

CATERPILLAR
Reg. U.S. Pat. Off.
HOLT
PEORIA, ILL.
STOCKTON, CALIF.

Rockford Finds A Better Way

* * *

Prior to the purchase of a "Caterpillar"* T-35 tractor, the city of Rockford, Illinois, used a gang of men to spread screenings and gravel ahead of the steam roller on street resurfacing jobs. This method was not only tedious and expensive, but the results were often unsatisfactory, as the laborers would get too much gravel in one place and too little in another. When the "Caterpillar"* was put to work pulling a spreader rigged to carry several yards of screenings, the City engineers said: "That's the method." The even gait at which the "Caterpillar"* traveled not only insured a steady, uniform flow of screenings but always kept the work well ahead of the roller. In addition to resurfacing jobs, Rockford keeps the "Caterpillar"* busy maintaining its dirt streets and alleys. No other machine is comparable to the "Caterpillar"* as an economical, all-purpose power producer for state, county, township and city work.. Our booklet, "Caterpillar Performance," tells why. Send today for your copy!

**There is but one "Caterpillar"—Holt builds it. The name was originated by this Company, and is our exclusive trade-mark registered in the U. S. Patent Office and in practically every country in the world.*

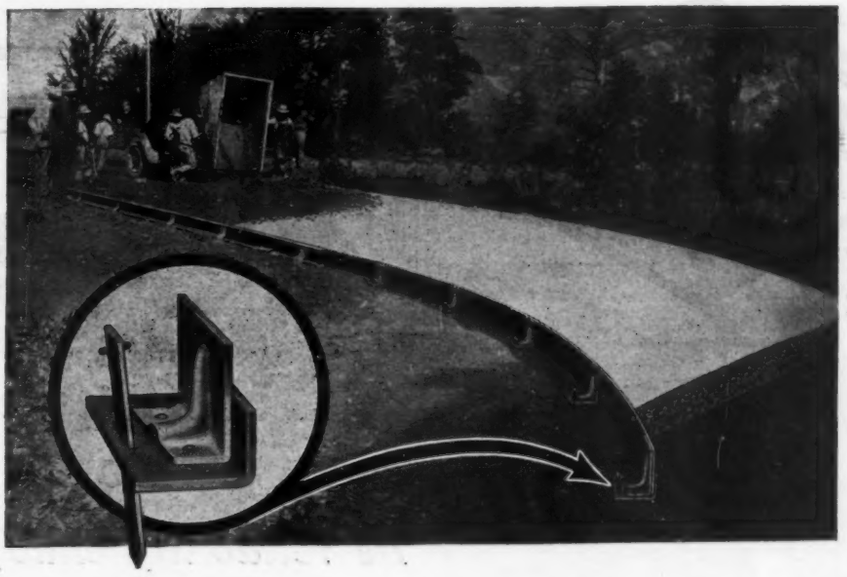
THE HOLT MANUFACTURING CO., *Inc.*, PEORIA, ILL.

Branches and service stations all over the world

Eastern Division, 50 Church St., New York

Omaha, Nebraska
Kansas City, Missouri
Chicago, Illinois
St. Louis, Missouri
Holt Company of Texas
Dallas, Texas

Des Moines, Iowa
Minneapolis, Minnesota
Indianapolis, Indiana
Canadian Holt Company, Ltd.
Montreal, P. Q., Canada



Are You Figuring on Roads With Extremely Sharp Curves?

HELTZEL FLEXIBLE RAILS will solve your problems

The illustration shows our flexible road rails made from ¼" steel 10′ lengths, supported by pedestals every three and one-third feet. Base plates are ¼" steel with a bearing surface of 50 sq. in. each, and will support a finishing machine. These flexible rails can also be used for straight work.

Heltzel forms have made a record for economy—depreciation is mighty small. They are easy to align, set up and take down. There are no keys or wedges on Heltzel Forms to get lost on the job; nor sleeves to connect rails. The pedestal does all.

Have you seen the Heltzel catalog?

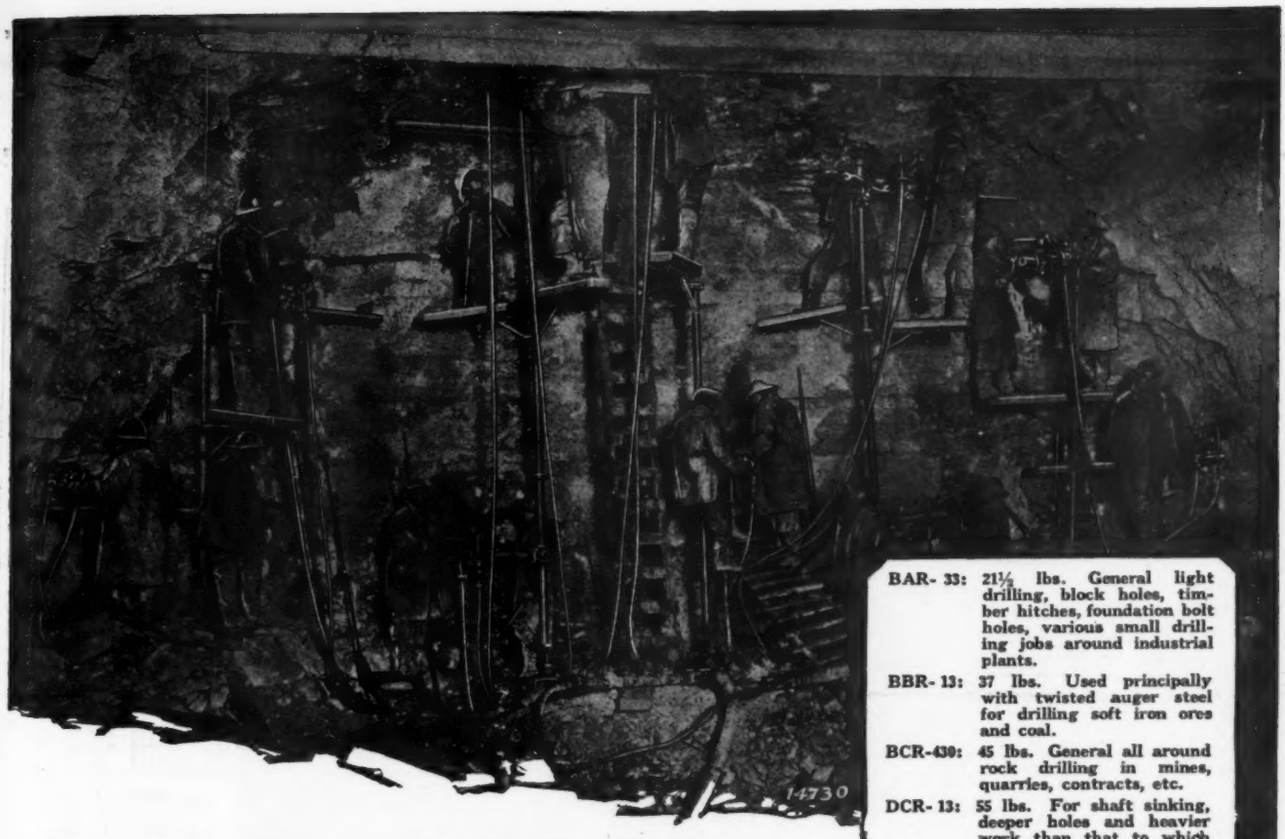
Drop us postal today.

THE HELTZEL STEEL FORM & IRON CO., Warren, Ohio

Largest exclusive builders of steel forms for Road, Sidewalk, Curb, Curb and Gutter and all types of concrete construction and Tamping Machines, Heltzel Hand Strikeoff Tamp, Heltzel Rotary Steel Float, and other accessories.

HELTZEL STEEL FORMS

BUILT LIKE A RAILROAD



BAR- 33: 21½ lbs. General light drilling, block holes, timber hitches, foundation bolt holes, various small drilling jobs around industrial plants.

BBR- 13: 37 lbs. Used principally with twisted auger steel for drilling soft iron ores and coal.

BCR-430: 45 lbs. General all around rock drilling in mines, quarries, contracts, etc.

DCR- 13: 55 lbs. For shaft sinking, deeper holes and heavier work than that to which the BCR-430 is applied.

DDR- 13: 70 lbs. For extra deep holes in very hard rock, shafts, quarries and similar duty.

Ten "Jackhamer" Drills Driving Immense Tunnel at Niagara Falls

The above photograph shows a top heading in a 36-ft. tunnel being driven at Niagara Falls, New York, for the Niagara Falls Power Company. This tunnel will be 4500 feet long when completed.

Such work is usually done by "drifter" type machines, but the contractors found that the light weight and extreme ruggedness of these small machines, combined with the fact that they may instantly be removed from their cradles and held by hand for drilling the benches, made the "Jackhamer" drills ideal for this work.

This work is being done by the Read-Coddington Engineering Company. All Ingersoll-Rand drills, sharpeners and air compressors are being used on this large project.

Descriptive literature covering any Ingersoll-Rand products will be sent you upon your request.

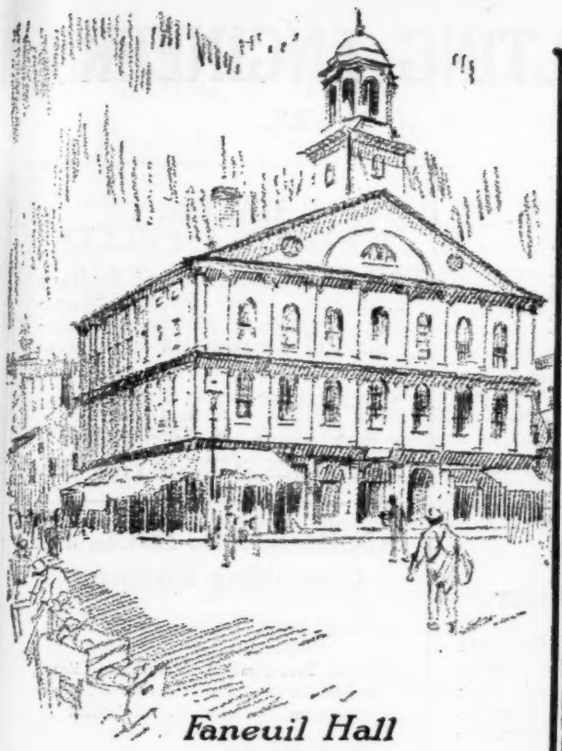
Request Bulletin 4046

INGERSOLL-RAND COMPANY, 11 BROADWAY, NEW YORK

Butte	El Paso	Knoxville	Cleveland	Philadelphia
Birmingham	Seattle	Scranton	Pittsburgh	San Francisco
Duluth	St. Louis	London	Los Angeles	Salt Lake City
Denver	Chicago	Paris	Detroit	Joplin
Boston	New York	Houghton	New Orleans	Dallas

259-JD

Ingersoll-Rand



Faneuil Hall
BOSTON

BOSTON AGAIN RE-ORDERS

AMERICAN-LAFRANCE FIRE APPARATUS

***"This company's products have stood the tests better than those of any other,"* says the Boston Post.**

THREE years ago the city of Boston appointed an impartial committee consisting of two municipal technical experts and one outside expert which conducted an exhaustive investigation of the leading makes of fire apparatus. This committee recommended that Boston purchase American-LaFrance motor apparatus because of its outstanding merit in actual fire duty, its efficient servicing record, and the unquestioned financial reliability of the company with its assurance of a permanent future.

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American-LaFrance fire apparatus is built so ruggedly that most cities re-order when their needs require additional purchases.

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PROVED AND ACCEPTED EXPANSION JOINT

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The traffic impact shatters the unprotected joint

A concrete road or city street expanded to the extreme in severe summer temperatures is under great stress at the joints. Every shock of traffic shatters and breaks down the edges of the concrete slabs — unless the joints are Elastite.

Elastite helps rigid pavements bear heavy traffic

THE pulverizing impact of tons of traffic doesn't injure the road with Elastite joints. Elastite resiliently cushions the concrete slab against shocks, strains and stresses, besides relieving stresses of expansion due to high temperature, preventing cracking of surfaces, and keeping joints water-tight and frost-tight in cold weather, thus protecting the sub-grade.

Elastite is a body of tempered asphalt sandwiched between two layers of felt. This construction prevents Elastite slabs from melting or sticking together in hot weather and from chipping or breaking in cold temperatures, as ordinary asphalt slabs will. Send for sample and list of cities where Elastite stocks are maintained for immediate shipments.

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10 Wayne Avenue, Lockland, Cincinnati, Ohio

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Elastite also protects the following structures:

New Sewage Disposal Plant, Milwaukee, Wis.
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BUYERS' CLASSIFIED DIRECTORY

of Names of Firms from Whom to Buy Material, Appliances and Machinery Needed by Public Works Departments and Contractors

CONTRACTORS' EQUIPMENT

(See Paving Machinery also)

Air Compressors
Ingersoll-Rand Co.
Schramm, Chris. D., & Son

Air Compressors, Portable
Ingersoll-Rand Co.

Ash Handling Mach.
Blaw-Knox Co.

Backfillers
Pawling & Harnischfeger Co.

Blasting Powder
Atlas Powder
Du Pont de Nemours Co.

Bodies, Stake and Rack, Trucks and Trailers
Detroit Trailer Co.

Bodies, Dump (Steel) Trucks and Trailers
Detroit Trailer Co.

Bodies, Gravity Side Dump (Steel)
Detroit Trailer Co.

Bodies, Steel Platform with Wooden Stakes and Racks for Trucks and Trailers
Detroit Trailer Co.

Braces, Trench
The Duff Mfg. Co.

Bridges
Blaw-Knox Co.
Russell Grader Mfg. Co.
Truscon Steel Co.

Buckets, Automatic & Dumping
Blaw-Knox Co.

Buckets, Clam Shell

Dragline, Orange Peel
Blaw-Knox Co.
L. P. Green
Russell Grader Mfg. Co.

Cars, Dumping and Industrial
Good Rds. Mchy. Co., Inc.
Equipment Co.

Carts, Concrete
Acme Road Mchy. Co.
Columbia Wagon & Body Co.

Castings
Burch Plow Works Co.
Republic Iron Works
South Bend Foundry Co.
U. S. Cast Iron Pipe & Foundry Co.

Chutes, Concrete
U. S. Cast Iron Pipe & Foundry Co.

Concrete Block Machines
Republic Iron Works

Cranes, Locomotive
Ball Engine Co.
Erie Steam Shovel Co.
Koehring Co.
Orton & Steinbrenner
Pawling & Harnischfeger Co.

Cranes and Hoists
Pawling & Harnischfeger Co.

Crushers
Acme Road Mchy. Co.
Good Rds. Mchy. Co., Inc.

Ditchers and Graders
Russell Grader Mfg. Co.

Drills
Ingersoll-Rand Co.

Dump Bodies, Steel
Columbia Wagon & Body Co.
Heil Co., The

Dump Bodies and Hand Hoists—Ford, Reo and other light trucks
Detroit Trailer Co.

Dump Wagons
Acme Road Mchy. Co.
Austin-West. Rd. Mach. Co.
Good Rds. Mchy. Co., Inc.
Heil Co., The
Tiffin Wagon Co.

Engines
Avery Co.

Excavators
Ball Engine Co.
Blaw-Knox Co.
Erie Steam Shovel Co.
L. P. Green
Koehring Co.
Pawling & Harnischfeger Co.

Explosives
Atlas Powder Co.
E. I. du Pont de Nemours & Co.

Front Bumpers
Detroit Trailer Co.

Garbage Bodies, for Trucks and Trailers
Detroit Trailer Co.

Hammer Drills
Ingersoll-Rand Co.

Heaters, Asphalt & Tar
Connery & Co., Inc.
Farasey, J. D., Mfg. Co.
Honhorst, Jos., Co.

Hoists
Ingersoll-Rand Co.
Pawling & Harnischfeger Co.

Hoists, Hand, for Trucks and Trailers
Detroit Trailer Co.

Hoists, Hydraulic and Hand for Motor Trucks
Heil Co.

Hose
Goodyear Tire & Rubber Co.

Jacks, Lifting
The Duff Mfg. Co.

Kettles, Asphalt & Tar
Connery & Co., Inc.
Honhorst, Jos., Co.

Loading Machines
Conant Machine Co.

Metal Lath
Truscon Steel Co.

Motor Trucks
Avery Co.
Tiffin Wagon Co.

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Rochester Can Co.

Paint
Ruberoid Co.
Servicised Products Co.

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Koehring Co.

Pintle Hooks
Detroit Trailer Co.

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Avery Co.
Burch Plow Works Co.
Russell Grader Mfg. Co.
Wiard Plow Co.

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Pneumatic Tools
Ingersoll-Rand Co.

Pumps
Aurora Pump & Mfg. Co.
De Laval Steam Turbine Co.
Emerson Pump & Valve Co.
Ingersoll-Rand Co.
Schramm, Chris. D., & Son

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Detroit Trailer Co.

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Ingersoll-Rand Co.

Shovels
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Avery Co.
Holt Mfg. Co., Inc.
Russell Grader Mfg. Co.

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Truscon Steel Co.

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Ball Engine Co.
Erie Steam Shovel Co.

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Goodyear Tire & Rubber Co.

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Detroit Trailer Co.

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The Hug Co.
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Loper Fire Alarm Co.

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Rochester Can Co.

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De Laval Steam Turbine Co.

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American-La France Fire Engine Co.

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De Laval Steam Turbine Co.

MISCELLANEOUS

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F. Weber Co.

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F. Weber Co.

Tanks, Welded Steel
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F. Weber Co.

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Asphalt Distributors

Asphalt Plants
Cummer & Son Co.
Farasey, J. D., Mfg. Co.
Hetherington & Berner
Warren Bros. Co.

Car Unloaders
Acme Road Mchy. Co.
Burch Plow Works Co.
Good Rds. Mchy. Co., Inc.

Concrete Mixers
Good Rds. Mchy. Co., Inc.
Jaeger Mch. Co., The
Koehring Co.
Republic Iron Works

Culverts, Corrugated Metal
Newport Culvert Co.

Gravel Screening Plants and Loaders
L. P. Green
Russell Grader Mfg. Co.

Heaters
Honhorst, Jos., Co.

Oil Distributors and Sprayers
Acme Road Mach. Co.
Austin-West. Rd. Mach. Co.
Connery & Co., Inc.
Good Rds. Mchy. Co., Inc.
The Kinney Mfg. Co.

Paving Breakers
Ingersoll-Rand Co.

Pumps—Oil and Asphalt
The Kinney Mfg. Co.

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Erie Steam Shovel Co.
Good Rds. Mchy. Co., Inc.
Russell Grader Mfg. Co.

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Austin-West. Rd. Mach. Co.
Good Rds. Mchy. Co., Inc.
Russell Grader Mfg. Co.

Road Levellers
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Russell Grader Mfg. Co.

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Austin-West. Rd. Mach. Co.

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Austin-West. Rd. Mach. Co.
Avery Co.
Buffalo-Springfield Rol. Co.
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Rochester Can Co.

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The Hug Co.

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Standard Oil Co., (N. Y.)
Texas Co.

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Standard Oil Co. (Ind.)
Standard Oil Co., (N. Y.)
Texas Co.

Bituminous Pavements
Barrett Co., The
Texas Co.
Warren Bros. Co.

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Republic Creo. Co.

Culverts, Corrugated Metal
Newport Culvert Co.

Curb Bars
Truscon Steel Co.

Expansion Joints
Barrett Co., The
Philip Carey Co.
Servicised Products Co.
Truscon Steel Co.

Fluxing Asphaltums
Standard Oil Co. (Ind.)

Oil (Roads)
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Headley Good Roads Co.
Standard Oil Co. (Ind.)
Standard Oil Co. (N. Y.)
Texas Co.

Paving Fillers
Standard Oil Co. (Ind.)

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Truscon Steel Co.

SEWERAGE

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Burch Plow Works Co.
The Robinson Clay Prod.
Russell Grader Mfg. Co.

Culverts, Corrugated Metal
Newport Culvert Co.

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Flush Tank Siphons
Pacific Flush-Tank Co.

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Ruberoid Co.

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Connery & Co., Inc.
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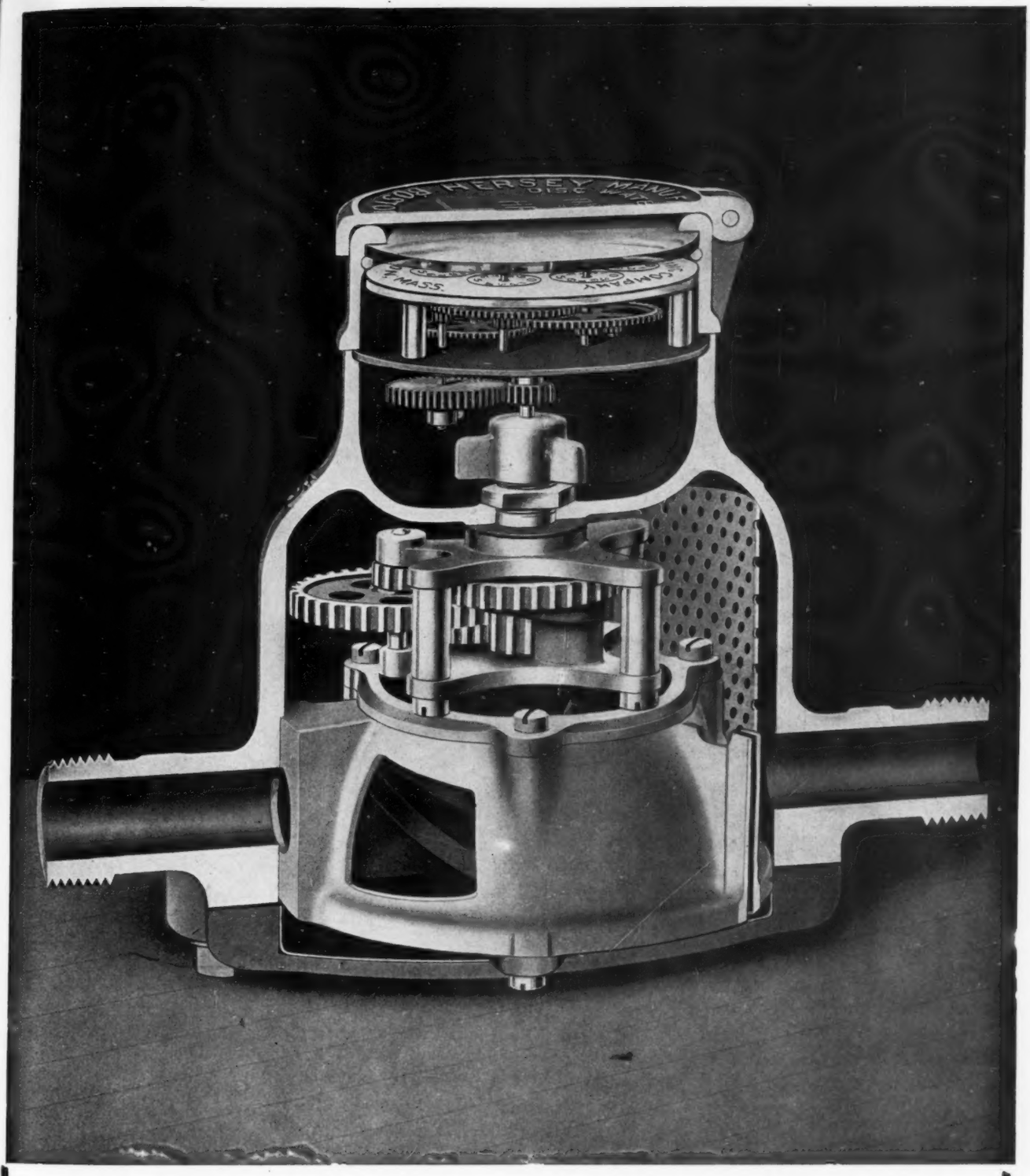

The Hersey Disc Meter, Model H F, is the product of thirty-five years of experience and refinement in the manufacture of Water Meters.

This Model in the smaller sizes, together with Model H D in the larger sizes, form a series which excels all Meters of all makes in all those essentials which go toward making up an exceptionally desirable Meter.

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In 1513 Juan Ponce de Leon, the Spanish explorer, representing the vanguard of the white man and his civilization, discovered and settled the territory of the present State of Florida. Subsequently, this territory passed through Spanish, French and English hands into the possession of the United States.

Endowed with the resources of the tropics, the "Land of Flowers" has been a fertile field of endeavor for its citizens, who from the beginning have realized its great natural wealth.

View of Texaco Asphalt Macadam on State Project in Alachua County, Fla. Total yardage, 216,000.

In Florida, the narrow, winding trail of the Indian has broadened and straightened out, assuming in the process an improved character with each new stage of the country's development.

What could be more logical than the ultimate development of these narrow Indian trails into those excellent, durable, resilient roads of TEXACO Asphalt to which Florida—like so many other States—now may point with a finger of pride?

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